Land Management Guide for Horse Owners and Small-Lot Farmers

Prepared by Langley Environmental Partners Society (LEPS)

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Introduction

Do you feel like you are drowning in a sea of mud and manure? Does your pasture have more bare patches than the Sahara Desert? Are the fish in your stream tired of hooves in their house? This guide is here to help!

The horse industry in British Columbia is growing at a rapid rate. In the 2001 census, Statistics Canada found that there were 53,366 horses and ponies on 6,820 farms in BC. The impact of all these animals on the land is substantial and we have a responsibility as horse owners to manage our properties in the most environmentally and socially sustainable manner possible. Managing manure, establishing and maintaining pasture grasses and dealing with water concerns are all part of good land management and this guide is meant to answer some of your hardest questions. It also contains recommendations on regional concerns for various parts of the Province.

This publication is divided up into four sections:

(1) Waste Management
(2) Pasture Management
(3) Water Management
(4) Regional Concerns

For each section we explore common questions and find solutions that are both economically and environmentally sound. There is an emphasis on natural or alternative methods of horse keeping and pasture management as we feel these are more desirable than the use of agrochemicals. There is also a lengthy list of suggested reading at the end for more information on any of the topics discussed.

We hope you enjoy this guide and wish you all the best in your future land management practices!

Agricultural Waste Control Regulation (http://www.qp.gov.bc.ca/statreg/reg/E/EnvMgmt/131_92.htm)

Section 13 – Agricultural waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater.

Section 15 – Agricultural waste may be composted on a farm if

(a) the agricultural waste being composted consists only of agricultural waste
(i) produced on that farm, or
(ii) produced elsewhere but being composted for use on that farm only,
(b) the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and
(c) the agricultural waste is composted in a manner that does not cause pollution

Fisheries Act (http://laws.justice.gc.ca/en/F-14/index.html)

Section 36 (3) – prohibits the deposit of deleterious substances into watercourses (deleterious substance could include cleanup water from concrete construction or eroded soil from construction)

Health Act (http://www.qp.gov.bc.ca/statreg/stat/H/96179_01.htm)

This Act has requirements under the Sanitary Regulations:
Section 9 – prohibits accumulation or discharge of wastes that endanger the public health

Drinking Water Protection Act (http://www.qp.gov.bc.ca/statreg/stat/D/01009_01.htm)

This act prohibits introducing, causing or allowing anything that will result or is likely to result in a drinking water health hazard in relation to a domestic water system.
The Drinking Water Protection Regulation defines potable water as:

no detectable fecal coliform bacteria per 100 ml
no detectable Escherichia coli per 100 ml
no detectable fecal coliform bacteria per 100 ml for a single sample in 30 days
at least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml for more than one sample in 30 days

Waste Management

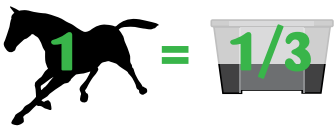
Waste management is a part of livestock ownership that many landowners are reluctant to discuss. However, it remains a necessary component of sustainable land management and one that is causing concern as fewer companies are agreeing to haul away manure. This leaves horse owners with very few options as to what they can do with their growing manure piles.

The average 455 kg (1000 lb) horse produces 8165 kg (9 tons) of manure per year, or 23 kg (50 lb) per day. This is a substantial amount of manure that needs to be dealt with in a safe and environmentally sound manner. Many horse owners and boarding facilities have their manure hauled away in 30 yard bins. Over the course of a year the amount of waste being removed depends on the number of horses on the property. These figures do not include bedding material removed from stalls or footing from paddocks.

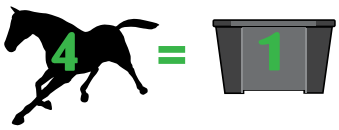
Volume = 27.68 m^3

Produces = 0.03 m^3 of manure/day

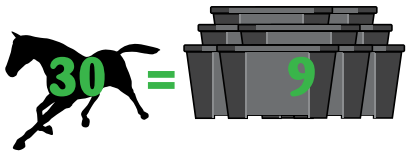
In One Year:



1 Horse = 1/3 Bin



4 Horses = 1 Bin



30 Horses = 9 Bins

Let us start by changing our perception of manure as a waste to be disposed of. Manure can be a beneficial nutrient resource for your land if handled properly. For example, 8165 kg of manure per horse per year translates to 45 kg (100 lb) of nitrogen (N), 8 kg (17 lb) of phosphorus (P), 28 kg (62 lb) of potassium (K), and 8084 kg of organic matter. These valuable nutrients can be used on pastures, gardens (as fertilizer or mulch), as landscaping material or as a liquid fertilizer (compost tea). However, raw manure needs to be transformed into a useable and efficient source of nutrients and one way to accomplish this is through composting. Composting is the best management tool for dealing with our mountains of manure and for transforming them into a valuable fertilizer resource.

Side Bar: There are a variety of acts and regulations that deal with the utilization and transportation of agricultural waste such as the Agricultural Waste Control Regulation, Fisheries Act, Health Act, and the Drinking Water Protection Act. These and other relevant legislation will be discussed throughout the guide with reference to the appropriate sections

A. Manure Composting

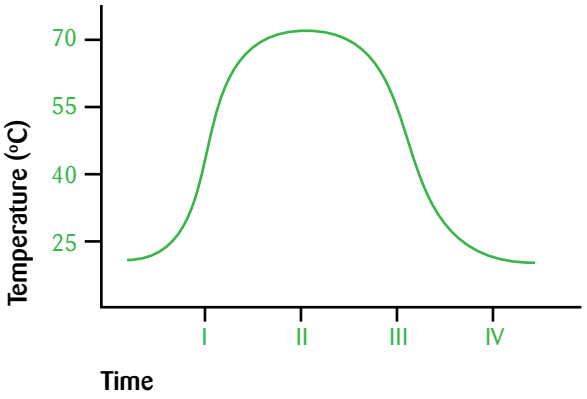
i. What is composting?

Composting is the natural recycling of organic matter such as grasses, leaves, branches, bark, kitchen wastes and manure. The process is carried out by microbes, fungi and other microorganisms (such as earthworms and beetles), which break down organic material into dark earthy smelling soil.

There are two types of composting processes that can take place within a manure pile: **aerobic** and **anaerobic**. Aerobic microbes require oxygen to survive and therefore aeration must occur within the pile through active or passive means. Anaerobic decomposition requires the activity of anaerobic microbes that cause the compost to ferment. As these organisms break down organic matter they release toxic gases such as methane, hydrogen sulphide and ammonia, which are extremely odourous. There is no significant release of heat in the anaerobic process, which means weed seeds and pathogens often survive anaerobic digestion. For these reasons, aerobic composting is recommended and will be the process that we discuss in this guide.

There are four main stages involved in the aerobic composting process: (I) the mesophilic stage, (II) the thermophilic stage, (III) the cooling phase and the (IV) curing phase. The diagram of the process can be found below (Figure 1).

Figure 1: **The composting process**



I– Mesophilic
II– Thermophilic
III– Cooling as decomposition rates decrease
IV– Finished compost that is stable at air temperature

The initial stage of composting is the mesophilic stage, which involves the mechanical break down of organic matter by larger organisms such as insects and earthworms. Next, the thermophilic stage is carried out by thermophilic bacteria, which survive at high temperatures. As the temperature in the pile heats up, the larger organisms vacate the manure pile and the thermophilic bacteria take over the composting process. As the temperature in the manure pile decreases it is re-colonized by the larger organisms and the final break down of organic material occurs. Finally, during the last stage of composting, the compost is left to cure and return to a low temperature. This curing phase is important since the longer the compost is left to cure, the more diverse the microbial community it supports will be.

ii. Why should I compost my animals' manure?

We often get questions about why it is beneficial to compost manure as opposed to spreading it raw on your fields. The act of composting can be time-consuming when compared to spreading raw manure, but the extra effort will be worth it in the long run.

Raw manure is not an effective fertilizer source. When raw manure is spread onto pastures the nitrogen (N) content tends to volatilize and immobilize, rendering it unusable for microorganisms. In order to replace the N content, the microbes in the compost will 'suck' it up from the pasture grasses. In contrast, through the act of composting, microbes recycle the nutrients they use and retain them in the compost, which creates a nutrient rich fertilizer source for your pastures.

Also, by spreading composted manure instead of raw manure you can protect local water resources. The run-off from raw manure can cause algal blooms and growth of other aquatic plants in nearby streams. When these plants decompose they deplete the water of oxygen content. As fish require oxygen to breathe they are not able to survive in this habitat. In addition, the run-off from manure piles can contaminate your drinking water supply and that of your horses if the piles are located near a well.

Some of the other benefits of using composted manure instead of raw manure are:

- Increased water-holding capacity of your soil
- Destruction of parasite eggs/larvae and weed seeds
- Reduced odour
- Reduced total waste volume
- Reduced cost of hauling manure off-site
- Reduced money spent on chemical fertilizers and soil amendments
- Easier manure handling
- Provides a great source of fertilizer for your pasture or garden.

iii. Where should I locate my compost bin?

When deciding on placement of your manure compost bin there are a number of things to keep in mind. Firstly, the setback distance from watercourses, wells and other sources of drinking water are important and are laid out in the Agricultural Waste Control Regulation.

Another issue to consider is the distance from your neighbours' properties. Manure compost bins will have reduced odour when compared to raw manure piles, but there will still need to be additions of raw manure to the compost. Therefore, wind direction should be accounted for and the bins placed accordingly. This is also important when taking your own house and property into consideration. You want to locate your manure compost as close as possible to your barn, shelter and/or paddocks, but far enough away that flies and odour do not affect you or your horses.

The topography and slope of the land should also be considered in placement of the bins due to potential leachate run-off. Bins should be located in areas that are "high and dry" and free from any drainage run-through. Additionally, if the area is level and dry it will be much easier to access and maneuver around with heavy machinery such as a tractor or truck. Proximity to the road is also important if you plan to remove your compost on a regular basis.

Agricultural Waste Control Regulation

Section 4 – Agricultural waste may be stored on a farm only if the waste is produced or used on that farm.

Section 7 (1) – A storage facility must be located at least 15 m from any watercourse and 30 m from any source of water for domestic purposes

Section 8 (1) Solid agricultural waste may be stored on a field for 2 weeks or less if the agricultural waste is
(a) used within 2 weeks, and
(b) stored in a manner that prevents the escape of agricultural waste that causes pollution.

Section 8 (2) Solid agricultural waste may be stored on a field for more than 2 weeks if the agricultural waste is

(a) stored for no longer than 9 months
(b) located at least 30 m from any watercourse or any source of water used for domestic purposes, and
(c) stored in a manner that prevents the escape of agricultural waste that causes pollution

Section 15 – Agricultural waste may be composted on a farm if
(a) the agricultural waste being composted consists only of agricultural waste
(i) produced on that farm, or
(ii) produced elsewhere but being composted for use on that farm only,
(b) the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and
(c) the agricultural waste is composted in a manner that does not cause pollution.

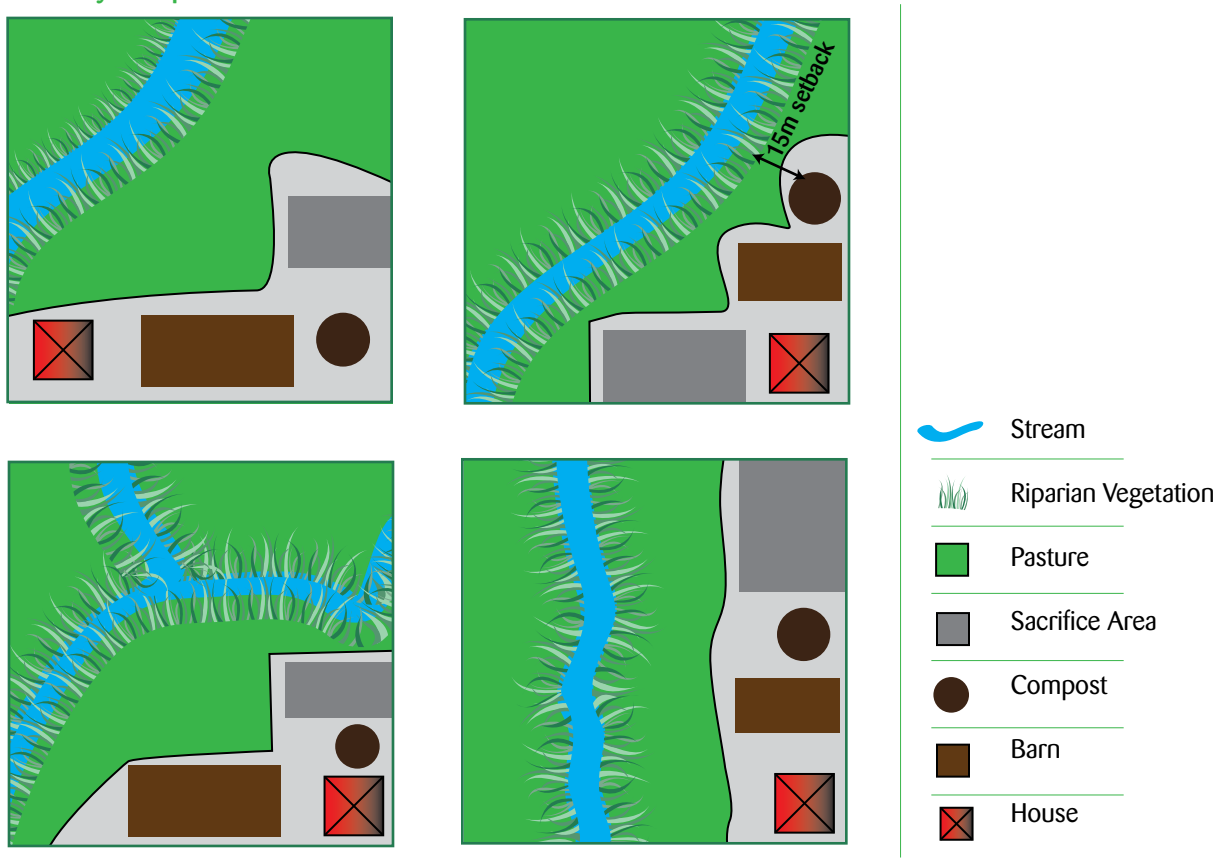
The Code defines "watercourse" to include drainage ditches that flow into surface water such as a lake, river, creek, canal, etc.

Health Act

Section 42 – provides separation distance from wells to be at least 30 m from any probable source of contamination (probably source of contamination could include fertilizers, compost materials, and leachate) and 122 m from any cemetery or dumping ground (cemetery could include buried mortalities)

Finally, take into consideration potential future expansion of your system. Horse owners are notorious for accumulating horses and you want to ensure that your system has room for another 8165 kg (9 tons) of manure per year if you add just one horse.

Farm Layout Options



iv. How do I build my compost system?

Type of Compost System

There are a number of composting systems available to choose from, such as windrows, static piles, in-vessel and bin composting. Each method is explained in detail below.

Passive Windrow Composting

This method involves the production of compost in windrows (extended piles) through natural aeration over long periods of time. This is a low technology and low labour approach, but the process can be sped up by paying attention to details such as the size of the initial particles and uniform mixing. This technique is often undesirable in small manure composting systems as the compost can generate odour and must be stored for long periods of time. PVC pipes can be used to speed up aeration, but only to a small degree.

Windrow composting with perforated PVC pipes inserted for aeration.

Turned Windrow Composting

This technique involves the production of compost in windrows using mechanical aeration. The compost is mixed while it is in the windrow using a windrow turner, which can be connected to a farm tractor (PTO), or self-powered. This is a low technology and medium labour approach that produces uniform compost. This process is desirable for large boarding facilities that are dealing with high volumes of manure and have the space to manage windrows.

Aerated Static Pile Composting

This method involves the production of compost in piles with mechanical aeration. The pile is located above air ducts, which force air into the compost either by blowing air up or drawing air through. This method can be simple with electrical motors, fans and ducts or highly sophisticated with sensors and alarms. This is a medium technology and low labour approach, but can result in a non-uniform product and the construction costs can be substantial. This is an effective technique for a commercial composting operation, but may not be suitable for small farms.

In-Vessel Composting

This involves the production of compost in drums, silos or channels using a large aeration system that is designed to provide optimal composting conditions. Composting is done through continuous agitation with aerating machines that operate in concrete bays or through fans providing air flow into ducts built into concrete flooring. This is a high technology and low labour approach, but the capital costs are substantial. This method is well suited to a commercial composting facility where the uniformity and quality of the finished product is the main concern.

Bin Composting

This system involves the production of compost within a bin by active or passive aeration. The compost mix is turned by equipment or by hand, depending on the size of the system. This is a low technology, medium labour approach that produces a medium quality product. This is the most common method for horse owners and small lot farmers as it produces compost fairly quickly and does not require a large amount of space.

Siding Material

After you decide on which method (i.e. turning by hand or with mechanical means) will suit your needs best you will need to decide what materials you will build your system with. The materials you choose are limited only by your imagination or budget and can be constructed from concrete, chicken wire, steel or wood. Concrete is considered the best material with which to build a composting system as it is non-permeable and will trap leachate and prevent it from being released into the environment. Steel siding is a less expensive option, but it can be difficult to ensure that the leachate is completely contained. Wood is another option, but it is important to remember that wood will degrade over time and may need to be replaced.

A good example of an inexpensive, temporary roof.

Roofing Material

One of the most important aspects to consider is how the system will be covered. Mentioned in previous sections, the Agricultural Waste Control Regulation requires that manure be covered in areas that receive a total precipitation average over 600 mm (24 in) between October and April such as in the Lower Mainland and coastal regions. Therefore, we must ensure that we have a way of covering our bins and piles that is user-friendly and effective.

Most horse owners use tarps to keep their system covered. This is an inexpensive option, but does require a bit of work when moving compost and manure in and out of the system. It can also be difficult to keep a tarp in place when winds and rainfall are severe. A more permanent option is a roof structure that is either stationary or can be moved out of the way when needed. It is important to note that in some municipalities a roofed structure can constitute a new building and you may need to gain a permit to build your compost system. Check with your local government before you begin construction. Another option is a temporary roof structure that can be screwed into place.

Size Concerns

The final issue to consider when building your compost system is how large it needs to be. In order to effectively store your manure compost you need to be able to determine the approximate size of your manure bins. The following calculations from the BC Environmental Farm Plan Reference Guide should give you a good idea of how large your system needs to be. These are general guidelines to follow and are over-estimates in order to compensate for bedding material added to the system. You know your property better than anyone and can decide for yourself what the most appropriate measurements will be for your compost system.

Calculating Compost Bin Sizes

Estimated daily manure volume for horses:

26.1 Litres/day waste production (Average 450 kg horse)
56.6 L/day suggested solid manure storage

Determining storage duration:

Typically, 6 months (180 days) of storage is required for the Fraser Valley and Vancouver Island. Other parts of BC may need 7 months (210 days) or more of storage. Variations depend on grass species, soil type, soil temperature and local rainfall. Storage requirements are less on farms where manure is spread on grasslands or well-drained soils. Composting slows down dramatically during the winter months and will stop completely if the air temperature is too cold. Therefore, Northern regions may require greater than 7 months of storage.

Determining storage size:

Step 1: estimate daily manure volume using equation 1a
1a) Farm daily manure production = number of horses x horses' daily manure production rate

Step 2: determine manure storage required using equation 1b
1b) Manure storage requirements = farm daily manure production x days of storage required (180 or more days)

Step 3 and 4: determine using equation 2a and 2b
2a) Effective depth of storage = chosen storage depth – freeboard safety (typically 0.2 m)
2b) Storage length = total manure storage requirements / effective depth of storage / storage width

See the Side Bar for some example calculations to get you started.

Here are some example calculations to get you started.

For a horse property with 5 horses and 6 months of storage required (in metres).

Daily manure production = number of horses x horses' daily manure production rate

Daily manure production = 5 horses x 26.1 L/day = 130.5 litres/day

Divide by 1000 and round to one decimal place to get metres cubed = 0.1 m^3/day

Manure storage requirements = daily manure production x days of storage required

Manure storage requirements = 0.1 m^3/day x 180 days = 18 m^3

Effective depth of storage = chosen storage depth – freeboard safety

Effective depth of storage = 2 m – 0.2 m = 1.8 m

Storage length = total storage required / effective depth of storage / storage width

Storage length = 18 m^3 / 1.8 m / 3 m = 3.3 m

It is also possible to calculate storage requirements with a more user-friendly approach. If you keep track of the number of wheelbarrow loads that you remove from your fields and stalls each day then you can calculate the volume of manure that needs to be stored.

Here is an example calculation to demonstrate this technique:

For a horse property with 5 horses removing 4 wheelbarrow loads per day and 6 months of storage required (in feet):

Daily manure production = wheelbarrow loads per day x size of wheelbarrow

Daily manure production = 4 loads x 4 ft^3 = 16 ft^3 per day

Manure storage requirements = daily manure production x 180 days

Manure storage requirements = 16 ft^3/day x 180 days = 2880 ft^3

Effective depth of storage is 5 ft with 10 ft x 10 ft bins

Storage length = total storage required / effective storage depth / storage width

Storage length = 2880 ft3 / 5 ft / 10 ft = 57.6 ft

Bin dimensions should be 10ft wide x 57.6 ft long x 5 ft high. (To convert to metres, multiply by 0.3 m)

Sample Building Designs

Good

This system is well set up in that the manure is contained in a small area and it is covered. However, there is no base on the bin to prevent leachate from entering the groundwater. Also, the system is made from wood, which means that it will eventually need to be replaced.

Better

This system is even better because of the substantial roof that has been placed over the structure. It has an impermeable base of concrete and slatted slides for increased airflow. However, the wood building material will also eventually need to be replaced and is not as durable when turning the compost with a tractor. The roof is also peaked instead of sloped, which causes runoff at the front of the system and can be difficult to work under.

Best

This system is ideal. It has been constructed from concrete forms and is fully contained with a concrete base and a roof. The roof is sloped to allow rain to runoff to the rear of the system and high enough to work under.

vi. What do I put in my compost system?

The important thing to consider when it comes to composting is that we are essentially feeding the organisms that are composting for us. The reason that we need to maintain an appropriate balance of materials in our compost bins is to ensure that we provide the right food sources for the microorganisms breaking down the organic matter.

Compost microbes require carbon for energy and nitrogen for growth so it is important to ensure that there is an adequate balance of each. Materials that are high in carbon include dead leaves, straw, wood chips, paper and shavings. Essentially, these are materials that are brown in colour. Substances that are high in nitrogen include fresh leaves, grass clippings, vegetable waste and hay. Typically, these are materials that are green in colour.

Characteristics of Composting Materials

Material	Nitrogen (Dry Weight) (%)	Carbon: Nitrogen Ratio (Dry Weight)	Typical Moisture Content (%)	Bulk Density at Moisture Content (kg/m3)
1) Horse Manure with Bedding -with straw bedding -with shavings	1.4-2.3 1.5 0.9	22-50 27 65	59-79 67 72	725-960
2) Beef Cattle -feedlot with bedding	1.3	-	68	-
3) Dairy Cattle -Solid manure handling -Liquid slurry -Solids separated from slurry	 1.7 2.4-3.6 1.45	 18.0 - -	 - 88-95 23	 - - -
4) Poultry -Broiler breeder Layer -Broiler Litter -Turkey Litter	 3.6 4.7 4.2	 10 15 14	 46 25 33	 470 330 380
5) Sheep Manure	1.3-3.9	13-20	60-75	-
6) Fish Scraps & Mortalities	6.5-14.2	2.6-5.0	50-81	-
7) Oat Straw	0.6-1.1	48-98	-	-
8) Wheat Straw	0.3-0.5	100-150	-	-
9) Legume Grass Hay	1.8-3.6	15-19	10-30	-
10) Straw	0.3-1.1	48-150	4-27	58-357
11) Grass Clippings	2.0-6.0	9-25	82	180-260
12) Grass Clippings & Other Gardening Waste	2.0	19.3	15	250
13) Leaves (freshly fallen)	0.5-1.3	40-80	38	60-80
14) Paper	0.2-0.25	127-178	18-20	-
15) Sawdust	0.06-0.8	200-750	19-65	350-450
16) Woodwaste (chips)	0.04-0.23	212-1313	-	445-620

Source: Composting Factsheet: Characteristics of On-Farm Composting Materials (1996) BC Ministry of Agriculture and Food

When composting, it is important to maintain the correct Carbon : Nitrogen (C:N) ratio to support the microorganisms. The ideal C:N ratio is between 25:1 and 50:1 and horse manure lies between 20:1 and 40:1 so when shavings are added the ratio is thrown out of balance. We need to correct this by combining the appropriate amount of both carbon- and nitrogen-rich materials.

Material	C:N Ratio
Horse manure	20-40:1
Grass clippings	25:1
Horse manure with bedding	30-60:1
Grass hay	30-40:1
Straw	40-100:1
Paper	150-200:1
Wood chips. sawdust	200-500:1

Source: Caring for Alberta's Rural Landscape: Manure and Pasture Management for Horse Owners (2003), Alberta Agriculture, Food and Rural Development

A soil testing kit from a local garden retailer will help you to determine the amount of nitrogen in your compost. If the nitrogen content is too low then you will need to decrease the amount of carbon in your compost pile. Reducing the amount of bedding material (or carbon) is essential to producing high quality finished compost. Also, if you spread compost onto your pastures that has too high a carbon level then the compost microbes will 'rob' your pasture grasses of nitrogen in order to complete the composting process. This is the opposite effect of what you want to see happen in your pastures. In section D we will discuss alternative bedding options for use in your stalls to minimize the carbon entering your compost system.

Another way to balance your C:N ratio if the nitrogen content is too low, is to add some grass clippings to your manure pile and mix them in thoroughly. You can also add vegetable scraps from your kitchen to offset the carbon content, simultaneously decreasing your household garbage. For a more information on soil testing see the section on Soil Analysis in the Pasture Management chapter.

Materials High in Carbon:	Materials High in Nitrogen:
Dead Leaves	Fresh Leaves
Straw	Grass Clippings
Wood Chips	Vegetable Waste
Shavings	Hay

vii. How do I manage my compost system?

Now that you have constructed a compost system and put in the right materials, the next step is to monitor the composting process and make sure all components in your system are managed properly. There are three main things to keep in mind when composting: Aeration, Moisture and Temperature. We will discuss each one of these separately and how to manage them.

Aeration

It is very important that airflow is maintained throughout the compost. The microorganisms that are breaking down the compost materials are aerobic and require oxygen to breathe in the same way we do. Therefore, we need to make sure that oxygen can freely move into the system while carbon dioxide moves out. The right amount of oxygen in our compost will also ensure that we eliminate odours and will help to reach the critical composting temperature.

Perforated PVC pipes inserted for aeration.

There are two methods to increase aeration in your compost: Passive and Active. Passive aeration is effective in small-scale operations with 1 to 6 horses and involves the use of perforated PVC drain pipes. These pipes are inserted vertically into the compost pile every 2 feet to allow oxygen to enter the pile and carbon dioxide to escape. This method takes a bit longer than active aeration and the raw materials may not appear as broken down, but it will still produce compost effectively.

The second method of aeration is through active management. This is appropriate for larger farms or for those "tractor-happy" people in your life. A tractor with a front-end loader is used to mechanically turn over the compost pile at least once every 3 weeks. The compost process is much faster this way and you can have finished compost in 1 to 3 months.

With both methods, it is important to remember to mix the cooler compost on top with the hot compost in the center from time to time. This ensures that you destroy the weed seeds and parasites in the exterior compost by bringing them into the center and allowing them to heat up. As a rule of thumb it is a good idea to turn your compost when temperatures in the pile fall to 35 degrees Celsius or when they rise above 65 degrees Celsius.

Moisture

Moisture content of the compost pile plays an important role in the metabolism of the organisms breaking down the materials. The optimal moisture content is between 40- 60% and the compost should feel like a damp, wrung-out sponge. It is important to check your moisture content weekly, especially during the summer months when your pile will dry out. If this happens, then you can add some water and do the "Squeeze Test".

The "Squeeze Test" involves putting your hand into the middle of the compost pile and grabbing a clump of compost. When you squeeze this clump together it should feel damp, but shouldn't drip water. If the compost breaks up in your hand then it is too dry and you need to add water. You may consider catching rainwater in a rain barrel during the wet season to water your compost pile when needed in the dry months. Fresh horse manure has an average moisture content of 70%, so it is important to add a small amount of straw, dead leaves, shredded bark or old hay to dry it out. This is especially important for those who are composting without shavings. Excess moisture can displace oxygen and lead to anaerobic conditions or increase the opportunity for leaching. This can also be avoided by ensuring that your compost system is covered. When in doubt, **Keep It Covered!**

The Squeeze Test.

Temperature

As the microorganisms are working to break down the composting process heat is generated within the pile. The optimal temperature range is between 55 and 65 degrees Celsius (90 to 140 degrees Fahrenheit), which should be maintained for at least 21 days. The purchase of a compost thermometer from a local hardware or gardening store will make it easy to monitor the temperature. However, the stem of the thermometer must be long enough to reach into the center of the pile or you will only get an exterior reading.

If the temperature is too high, the heat will kill off the microorganisms. If the temperature is too low, it means that the material is not composting or being broken down. If you have allowed it to compost for 21 days and the temperature is still too low, check to see if the composting process has finished. If it isn't finished then you may need to shred or grind the materials to increase the surface area.

Composting Over Winter

Composting during the wintertime, especially in colder climates, can be a tricky endeavour! The biggest challenges are keeping the compost pile warm enough and making sure the microorganisms have enough food.

In areas with heavy snowfalls, composting can become a serious challenge. One trick is to keep the snow from direct contact with your manure pile. Tarps or roof structures should be placed over the piles to ensure that snow is not getting into the compost. Snow can very quickly cool down the composting process and halt it completely. However, when snow is separated from the system via a tarp it can provide insulation to the pile and actually increase temperatures. Surrounding the piles with straw bales can also act as an insulating mechanism to maintain higher temperatures. If snow does happen to get onto the compost, don't turn it, as this will cool the pile.

Additionally, the microorganisms in the system need to have a constant source of food in order to continue the composting process. It is recommended to put down a layer of wood chips 6 to 8 inches deep at the bottom of the system. Then you should follow this up with 2 to 3 ft of leaves and alternate manure and bedding. By the time spring rolls around the leaves will have decomposed and the pile will need turning, but the composting process should be nearly finished. This is especially important if you are unable to access your system due to excessively wet weather or heavy snowfalls. For fresh manure produced over the winter, layer your empty compost bins with the wood chips and leaves and add fresh manure until full. Cover these and allow to compost.

Ensuring that your compost bin stays warm and that the microbes have enough food will help in maintaining the compost process throughout the wintertime.

vii. What do I do with my finished compost?

When you have determined that your compost has finished decomposing and has gone through the curing phase then you are ready to use it. There are varying degrees of finished, and what might be fine for one person may not be adequate for another. If a temperature of at least 55 – 65 degrees Celsius has been maintained for 21 days (or three weeks) then you can be quite confident that it is finished and that weed seeds and parasites have been killed. It may not look finished and the raw materials may look like they haven't broken down, but the temperature is the important part. If you prefer to have a more broken down appearance then turn the pile a few more times and let the microorganisms continue. It is also possible to run the compost through a mesh screen to remove the larger materials and then add these back to the actively composting pile. The final moisture content of the compost should be approximately 50%.

Finished compost can be used on pasture grasses to increase fertility, help maintain water holding capacity and increase soil structure and drainage. If the compost is still a bit clumpy when spread then you can attach a chain harrow to the back of your tractor and run it over top to break it down further. A chain harrow can be constructed from a piece of chain link fencing with 8x8 boards attached on both ends to weigh it down.

You can also use finished compost on gardens and landscaping as a mulch or soil amendment. It provides a great fertilizer and will help to keep the weeds down. It can also be a good growth media for mushroom and worm farms. Pass it along to your neighbours and they'll be begging for more compost next year!

B. Improving Current Practices

i. How can I improve my current waste management practices?

Ensuring that our animals' manure does not threaten human health or our natural environment doesn't always mean that you have to completely change your current manure management practices. Sometimes one small change can make all the difference. Here are some tips to help you improve upon what you are currently doing.

Keep Your Manure Pile Covered

In the Lower Mainland, an uncovered manure pile, on average, receives 1 metre of rainfall every year. As the water runs through a manure pile it picks up significant amounts of organic materials, nitrate-nitrogen, ammonia and other organic compounds, which can contaminate surface and groundwater. By covering your pile, even with a tarp, you will be helping to ensure the health of your community and your environment.

Consider the Location of your Manure Pile

Carefully evaluate the location of your stored manure. Is it located close to a drainage ditch, stream or small waterway? If so, then move your pile away from watercourses to help ensure the health of aquatic life, such as salmon. Even if your watercourse does not contain fish, it may still provide a significant source of food and clean water for fish living downstream. It is important to remember that even drainage ditches lead to larger tributaries in a watershed.

Manage your Manure Piles

In order for manure piles to break down successfully they need to be managed. Keeping close tabs on moisture content, temperature and oxygen will go a long way to producing good quality compost and fertilizer. Piles that are left to sit for long periods of time will not compost properly since the organisms needed to break down the materials are not exposed to the right conditions. Managing your manure pile by providing it with oxygen and the correct moisture content can ensure that you are creating good quality compost. Inserting perforated PVC drainage pipes vertically every 2 feet into the manure pile will help to bring air into the pile and give the microorganisms the oxygen they need. Managed piles also have less odour and fewer insects hanging around them than unmanaged piles (see section B: Manure Composting for more information)

Agricultural Waste Control Regulation

Section 9 – In areas of the Province, including the Fraser Valley and Vancouver Island, that receive a total average precipitation greater than 600 mm (24 in) during the months of October to April inclusive, field stored solid agricultural wastes, except agricultural vegetation waste, must be covered from October 1 to April 1 inclusive to prevent the escape of agricultural waste that causes pollution.

C. Compost Troubleshooting Guide

Symptom	Other Clues	Possible Cause	Solution
Pile fails to heat	Pile appears soggy	Pile is too wet	Turn and/or cover pile.
	Material does not stay together when squeezed	Pile is too dry	Add water evenly with hose or sprinkler.
	Higher amounts of bedding than manure	Not enough nitrogen (C:N ratio is incorrect)	Add high nitrogen ingredients and/or try to reduce bedding.
	Pile height is less than 1 m (3 ft) and only warm in the middle	Pile is not high enough	Continue to add material to pile or combine more than one pile so that it is at least one cubic meter (3.5 x 3.5 x 3.5 ft).
Temperature falls but compost is not finished yet	Temperature declines gradually	Lack of oxygen. Pile is settling and airflow is limited.	Improve aeration by turning or inserting perforated PVC pipes. Add bulkier materials to pile.
	Material does not stay together when squeezed	Pile too dry	Add water evenly with hose or sprinkler.
Inside of the compost pile is dry		Pile is too dry	Add water and break up outside layer by turning.
Bad odour is detected from the pile	Pile appears wet/soggy with a low temperature	Pile is too wet and there is not enough oxygen	Turn pile and/or insert perforated PVC pipes. Cover pile and/or add bulkier materials.
	Pile appears to have a lot of green materials (high in nitrogen)	Too much nitrogen and an incorrect C:N ratio	Add high carbon materials such as straw, bedding, or dead leaves.
High fly populations	Flies swarming around the compost pile	Flies breeding in the un-composted manure	Look for other reasons that the material is not composting properly.
			Add a layer of finished compost on top to prevent fly access.
			Cover pile with a tarp.
Temperature is too high	Pile appears dry	Not enough water	Add water with hose or sprinkler.
	Pile is dense and compacted	Not enough air	Turn and/or insert perforated PVC pipes. Add bulkier materials.

D. Alternative Bedding

i. Why should I use other forms of bedding material?

Using an alternative bedding source, other than the conventional shavings or straw, is a great option to reduce the amount of carbon materials going into your compost and reduce the total volume coming out of your barn each day. Studies have shown that by using products such as wood pellets, you can reduce the carbon levels in your compost by almost 40% and the total daily volume by 50%.

Another concern with materials such as wood shavings is that the wood could be treated with toxic chemicals to maintain a long life span. These chemicals are sometimes not removed before the wood is broken down into bedding. This is very rare but has been known to occur. These chemicals can be detrimental to the local environment if leachate is allowed to escape and can also be harmful to your horses' health.

You will also want to ensure that your shavings are made from appropriate wood species. Horses should never be bedded on black walnut as it can cause laminitis. Furthermore, shavings from recycled construction lumber should be avoided as they can contain metal chips and filings.

Rubber mats and wood pellet bedding in a single horse stall

ii. What other forms of bedding material are available?

Rubber Mats

One option that is becoming more and more popular with horse owners is the use of rubber mats. These mats are laid in the bottom of the stall to provide the cushioning that horse owners want for their animals, but minimize or eliminate the amount of shavings needed in the stalls. They can be costly, but the savings that result in the long run will be worth the initial cost. Rubber mats will cut your stall cleaning time, reduce airborne dust, reduce the risk of thrush and other hoof problems and are easy to install.

Shredded Newspaper/Cardboard

Shredded newspaper or cardboard is another great option for bedding. It is highly absorbent, composts very well and is ecologically sound. Just ask your local newspaper if they have shredded roll ends that they would consider donating. Most newspapers utilize vegetable-based inks these days, but it is worth asking, as chemical-based inks are undesirable for compost systems.

Wood Pellet Bedding

Another option is the use of wood pellet bedding. Wood pellets are a byproduct of the lumber industry and consist of wood fibers that have been sorted by size, compressed, heat treated and sterilized to remove tars, oils, hydrocarbons and other

Wood pellet bedding in group-housing.

Wood pellet bedding in a single horse stall.

allergens. When water is added to the pellets they expand in size and can absorb 9 times more liquid than regular shavings. Using wood pellets can reduce the amount of waste you are removing from your stalls and lower the costs of stall bedding.

Wood pellet bedding composts much quicker than shavings or straw, which often do not fully compost or take a long time to decompose. When providing site consultations, we commonly see manure piles several years old and the sawdust looks almost exactly the same as the day it went into the pile. In contrast, wood pellets expand with use and break down quickly and easily. Thus the product that ends up in the compost system has a much smaller particle size.

iii. How do I use wood pellet bedding?

The Art of Using Wood Pellet Bedding

Using wood pellet bedding is indeed an art form, as many of the "converted" will tell you. Many people give it a try for a short time, say they don't like it, and never use it again. It definitely takes a bit of practice to use wood pellets well and you really do need to give yourself some time to get used to it. Practice makes perfect! We hope the following tips will help you transition quickly.

Purchasing the Bedding

If you are looking for a source for this type of bedding, many local feed stores and businesses that sell fuel for wood stoves will sell bags of wood pellet bedding. The product is generally sold by the bag, and in many places, if you buy a pallet (which contains about 50 bags) the price per bag will be cheaper. There are a number of brands available, each with their own advantages and disadvantages, so you will have to experiment to figure out which one will work best for you. Make sure you find a brand that is guaranteed for use in the livestock or horse industry. It is recommended to find brands that use organic softwood lumber, restrict particle size to reduce dust, disallow hardwood materials that can be toxic for use with horses and limit the use of bark or knots.

Getting Started

In general, you will need between 4 and 7 bags to fill a 12 x 12 stall, depending on how deep you prefer to bed your animals. Keep in mind that the product continues to expand as you use it so if it looks a little sparse in the beginning it will fluff up considerably over the first week of use.

Pour a couple of bags of the pellets into your wheelbarrow and add enough water to dampen all of the pellets. Watering the bedding prior to putting it in your horse's stall will help the wood pellets to expand more effectively, absorb more and last much longer. Pre-watering also stops the horse from crushing the pellets or slipping. Once the pellets have been sufficiently

watered, leave the wheelbarrow for at least one hour to allow the pellets to expand. If only a small amount of expansion has occurred add more water and wait for a bit longer.

Once the pellets look like they are expanding and are 'sawdust-like' put them in the stall and repeat the process until you are happy with the thickness of the bedding. Having multiple wheelbarrows makes this process quicker and easier! If you have a larger wheelbarrow you may be able to do more than 2 bags at once.

Stall Cleaning

Cleaning your horse's stall will be a little different from using shavings. If you have used scoopable cat litter your stall cleaning is going to be quite similar. The urine will clump into a puck-like shape, which can be easily scooped out. Keep in mind that sometimes the urine 'puck' will break apart so just take out the solid parts and leave the rest in the stall. The moisture from the excess urine will help the product to continue expanding. Odour will not be a concern as pine is a natural deodorizer; however, if you are really concerned there are deodorizing products available for purchase from many retail outlets.

Once you have picked out the manure and urine, thoroughly mix the bedding in the stall and pull fresh bedding in from the sides of the stall into the middle. If the bedding seems a bit dusty then sprinkle it with some water. This can be done frequently, as it will help the bedding to continue expanding.

You will need to add approximately 1-2 bags of fresh bedding to your stalls each week using the process outlined above. It is helpful to get the new bedding started in a separate wheelbarrow while you clean the stalls so that it is ready to add when you are finished cleaning. You will probably want to completely strip and restart each stall every 2-3 months, which will give the stalls time to air out and disinfect properly.

Agricultural Waste Control Regulation

Section 20 – Wood waste may only be used for
(a) plant mulch, soil conditioner, ground cover, on-farm access ways, livestock bedding and areas where livestock, poultry or farmed game are confined or exercised

Section 21 – Wood waste stored and used on a farm must be handled so as to prevent any escape of
(a) particulate or solid matter from the wood waste into the air, or
(b) particulate or solid matter or leachate from the wood waste into any watercourse or groundwater that causes pollution.

Section 22 – Wood waste used on the farm must not be used
(a) for landfill, and
(b) on sites within 30 m of any source of water used for domestic purposes with the exception of existing sites under use prior to April 1, 1992, provided that this use is not causing pollution

Woodwaste is often picked up with manure when cleaning paddocks.

E. Woodwaste Management

i. Why do I need to manage my woodwaste?

Woodwaste is not often considered a source of pollution, but when allowed to leach into nearby watercourses it can pose a serious risk for aquatic organisms. Woodwaste products include shavings, hog fuel, tree bark, wood chips and other forms of broken wood. When saturated with direct rainfall it can produce a toxic leachate that will pollute watercourses at low concentrations, and deplete oxygen levels in surface waters. Additionally, woodwaste leachate can tie up nitrogen (N) in the soil and make it unavailable for plant growth. Therefore, it is important to keep woodwaste covered in both manure storage piles and woodwaste storage facilities.

ii. What can I do to prevent woodwaste pollution?

Here are some guidelines that you can follow to ensure that you are properly managing the woodwaste on your property.

- Make sure applications of woodwaste do not exceed 15 cm (6 in) per year and 45 cm (18 in) in total. This applies to animal stalls, paddocks and arenas.
- Do not use woodwaste within 30 m (100 ft) of domestic water sources (wells) or within 30 m (100 ft) of a watercourse.
- Do not use woodwaste as landfill or backfill.
- Apply woodwaste only in April or May.
- Consider using alternative footing such as sand, gravel or crushed rubber.
- Level land before applying woodwaste.
- When storing woodwaste ensure that the storage facility is covered.

F. Carcass Management

i. How should I manage carcasses on my property?

Carcass management is generally not an issue that most horse owners have to deal with, but it is an important practice that needs to be discussed. There are bylaws, as specified by the Agricultural Waste Control Regulation, that need to be adhered to when dealing with deceased livestock on your property.

The most preferred method of disposal is by delivery to a rendering plant. However, some locations in BC do not have rendering facilities and burial becomes the common practice. It is important that before burial the carcass is moved to a dry, temporary holding facility while a site is prepared. The burial pit should be located at least 120 m (400 ft) from any wells and domestic water intakes and at least 30 m (100 ft) from any other surface water. The pit needs to be constructed so that the bottom is at least 1.2 m (4 ft) above the seasonal high water level and the top can be covered with at least 1 m (3 ft) of soil. Only one horse is allowed to be buried per pit (a total of 700 kg of carcass weight each), which should be distributed throughout the property. These burial pits should also be located in areas that are not subject to flooding or seepage.

For more information please see the Ministry of Agriculture and Lands Factsheet on Large Animal Disposal: On Farm Burial Option, South Coastal Region of BC.
http://www.agf.gov.bc.ca/resmgmt/publist/300Series/384300-3.pdf

Agricultural Waste Control Regulation

Section 23 (1) – Mortalities may be disposed of on-farm by burial or incineration if
(a) the mortalities are livestock, poultry or farmed game disposed of on the farm where they died,
(b) the disposal does not cause pollution,
(c) where disposal is to land, the burial pits are covered, located at least 30 m from any source of water used for domestic purposes and constructed to prevent the escape of any agricultural waste that causes pollution, and
(d) where disposal is by incineration, the emissions from an incinerator do not exceed 180 mg per cubic metre of particulate matter and 20% opacity

Section 24 – Mortalities may be composted on-farm if
(a) the mortalities are composted on the farm where they died,
(b) the composting site is located at least 15 m from a watercourse and 30 m from any source of water used for domestic purposes, and
(c) the composting does not cause pollution

Health Act

Section 42 – provides separation distance from wells to be at least 30.5 m from any probable source of contamination (probably source of contamination could include fertilizers, compost materials, and leachate) and 122 m from any cemetery or dumping ground (cemetery could include buried mortalities)

Forest Practices Code of BC Act (http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcact/contfpc.htm)

This Act has conditions under the Range Practices Regulations:
Section 7 (4) – requires dead livestock within 100 m of a watercourse in a community watershed be removed within 24 hours

Pasture Management

Pasture management is one of those tasks that is often overlooked, but it can have substantial benefits. Properly managed pastures can reduce feeding costs, health problems, erosion and runoff, weed concerns and minimize stall cleaning. This can be accomplished through a variety of techniques, which will be discussed in depth in this chapter.

Poorly managed pastures can create mud and dust, which can cause respiratory disease, sand colic and thrush. Lack of proper grass density and growth can create the perfect environment for topsoil erosion and pollution runoff. Also, through pasture maintenance you can meet many of the nutritional needs of your horse, which can greatly reduce feeding costs.

There are also regulations that need to be considered when managing pastures properly. The side bar on the following page is from the Agricultural Waste Control Regulation and deals specifically with grazing and seasonal feeding areas.

A. Pasture Renovation

Before you undertake any kind of renovation of your pastures you should do a full assessment of the current conditions. Things to consider include: weed identification, soil conditions, topography, grass species and grass density. It is impossible to know exactly what needs to be done until you know what is already present.

i. What is the difference between complete and partial pasture renovation?

Maintaining a healthy pasture for your horses can be achieved in one of two ways: partial or complete pasture renovation. Keeping your pastures healthy will help to keep your horses in good body condition, free of disease and well nourished. The following discussion outlines the differences between partial and complete pasture renovation in order for you to decide the best strategies to manage your pasture.

Partial Pasture Renovation

Most horse pastures in BC are in need of some repair, especially in the south coastal region. The wet climate and acidic soil conditions causes weeds to flourish and out-compete grasses. Even in the drier areas of BC there are issues with alkaline soils and lack of irrigation. Partial pasture renovation is ideal if your grasses appear to be lacking in density and somewhat overrun by weeds. This can include a combination of management strategies such as:

- Improving pasture drainage to eliminate the ideal growing conditions for weeds
- Implementing a weed management strategy to deal with the species present
- Liming to eliminate acidic conditions
- Aerating the soil to improve soil structure and drainage
- Spreading finished manure compost and harrowing
- Reseeding with a different seed mixture tailored to your growing conditions

It is important that you discuss with your local retailer or dealer to determine appropriate spreading rates for your pastures.

Complete Pasture Renovation

Complete renovation should be used only as a last resort due to cost and the fact that you will need to keep your horses off the pastures to allow the grasses to re-establish. However, if less than 25% of your pasture growth is composed of desirable plant species (i.e. pasture grasses) then a complete renovation is something you may want to consider.

The partial pasture renovation strategies apply in this case as well, but you may find that you need to cultivate or rototill the existing grass in order to develop a sufficient seedbed. Another consideration is the matching of plant species to the specific soil and microclimate environment in your pastures. Take note if your fields have low points that could be boggy or if there are forested areas that may be more acidic. The topography in a single field may vary substantially and knowing the lay of the land is important in choosing the most appropriate seed mixtures for your property.

Agricultural Waste Control Regulation

Section 25 – Livestock, poultry or farmed game feeding within a grazing area may have access to watercourses, provided that the agricultural waste produced by that livestock, poultry or farmed game does not cause pollution.

Section 26 (1) – A seasonal feeding area for livestock, poultry or farmed game must

(a) be operated in a way that does not cause pollution, and

(b) have berms where necessary to prevent agricultural waste runoff from causing pollution

Section 26 (2) – Locations for feeding livestock, poultry or farmed game within a seasonal feeding area, including locations for movable feed bunks, must

(a) be at least 30 m from a high tide watermark, a watercourse or the bank of a watercourse, unless written permission has been obtained from a director for a closer location, and

(b) be distributed throughout the area to ensure that manure from the feeding of livestock, poultry orfarmed game is spread as a fertilizer or soil conditioner and that no accumulation of manure causes pollution.

Section 26 (3) – Where permanent feed bunks are used within a seasonal feeding area, written permission for the location of the bunks must be obtained from a director.

Section 27 – Livestock, poultry or farmed game in a seasonal feeding area may have access to watercourses provided that

(a) the feeding of livestock, poultry or farmed game is in accordance with section 26, and

(b) the access is located and maintained as necessary to prevent pollution.

Selecting high quality seed and using a proven seed mixture will also give you a good head start in weed management. Ensuring that grasses are growing at a high density with no bare soil will ensure that weeds do not have a chance to establish. Keeping horses off the field until grasses are at a height of at least 15 to 20 cm (6 to 8 in) will be necessary in order to maintain grass density and resilience.

B. Weed and Poisonous Plant Management

i. Why do I need to manage my weeds?

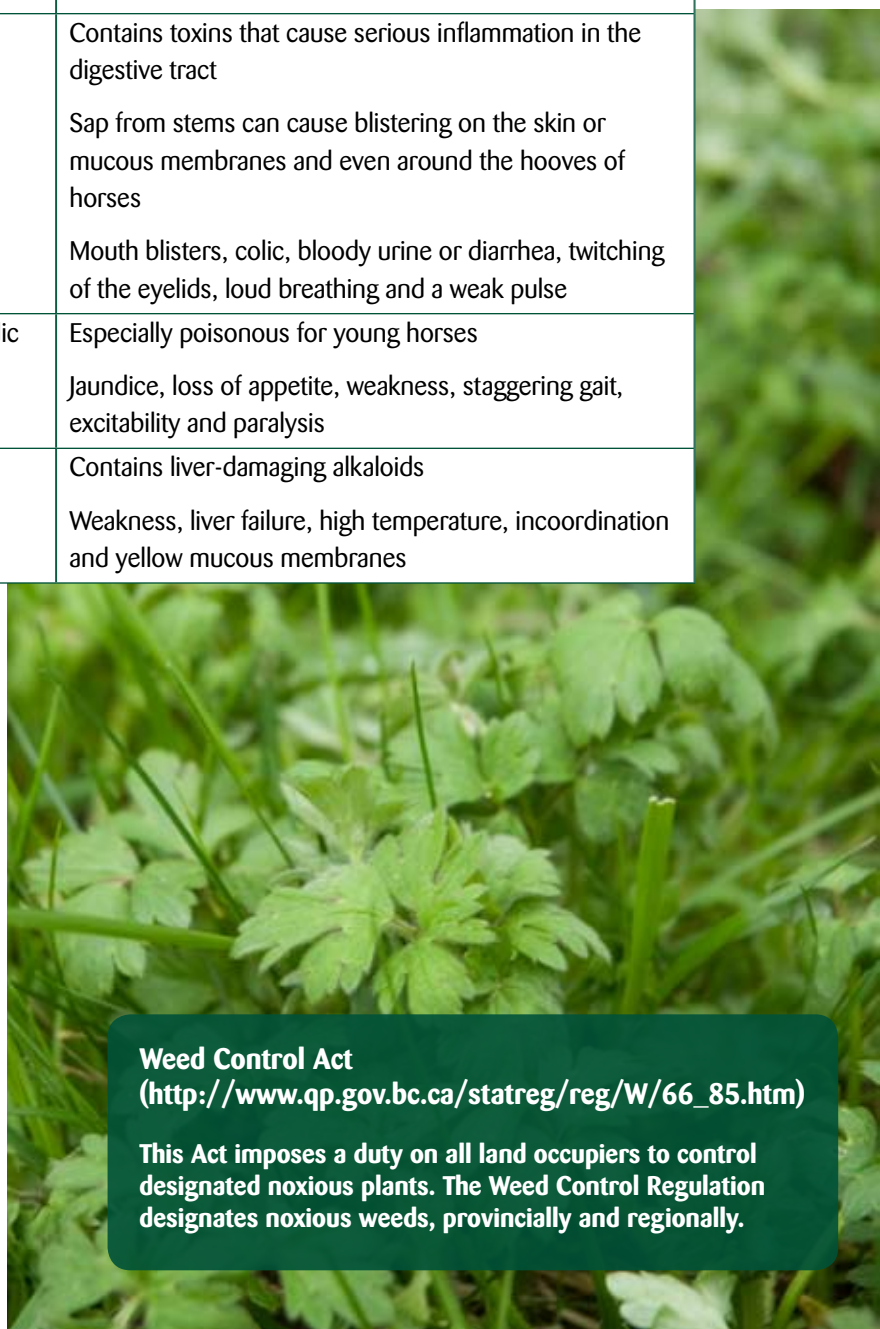
'WEED' is a nasty four-letter word to many landowners. The threat of weeds is often neglected and eventually they can get out of control. A good management strategy will limit the amount of time you spend on weed control and could help maintain your horses' health as well.

Weed species such as creeping buttercup, field horsetail and tansy ragwort are highly poisonous to horses, cattle and sheep and can cause serious health concerns. Horses have been known to consume all of these weeds when grass density and height are too low.

Weed Species Common to the Lower Mainland	Pasture Conditions that Encourage Growth	Detrimental Health Effects
Creeping Buttercup (Ranunculus Repens)	Acidic and wet (boggy) conditions	Contains toxins that cause serious inflammation in the digestive tract Sap from stems can cause blistering on the skin or mucous membranes and even around the hooves of horses Mouth blisters, colic, bloody urine or diarrhea, twitching of the eyelids, loud breathing and a weak pulse
Field Horsetail (Equisetum arvense)	Poorly drained and acidic soils	Especially poisonous for young horses Jaundice, loss of appetite, weakness, staggering gait, excitability and paralysis
Tansy Ragwort (Senecio jacobeae)	Damp and acidic conditions with sparse pasture grass	Contains liver-damaging alkaloids Weakness, liver failure, high temperature, incoordination and yellow mucous membranes

Early detection and early treatment is the trick for staying on top of weed growth. Weed species in the interior region may be different from those listed above and may need to be managed in a different manner (see Regional Concerns section). Correct identification of weeds is very important as this will help determine your management strategy.

Next, eliminate areas of bare soil by seeding with appropriate grass varieties. This will help to out-compete weeds as bare soil provides an ecological niche for undesirable species to exploit there is an increase in nutrient, water and sunlight. Also, make sure to check areas such as animal handling locations, watering



Weed Control Act (http://www.qp.gov.bc.ca/statreg/reg/W/66_85.htm)

This Act imposes a duty on all land occupiers to control designated noxious plants. The Weed Control Regulation designates noxious weeds, provincially and regionally.

sites, feeding areas and fence lines, as these are common weed spots. It is important to note that several regional districts may have bylaws in conjunction with the Weed Control Act that require a landowner to manage their weeds with the threat of fines or cost recovery if not adhered to.

ii. How do I control my weeds?

Ideally, prevention is the best mode of defense against weed infestations; however, this is not always feasible. Firstly, prioritize your weed management strategies; instead of attacking large infestations aim your efforts at controlling the spread and size. There are many physical and mechanical control methods that can be used; these are outlined below with their associated advantages and disadvantages.

Strategy	Advantages	Disadvantages
Pulling	No permit. Prevents seed production. Can use near water.	Soil disturbance. Timing. Must generally repeat treatment. Labour-intensive. Costly. Root fragments may remain. Moist or loose soils required for pulling.
Mowing/cutting	No permit. Prevents seed production. Can use near water. No soil disturbance.	Roots remain, and plant may re-sprout or grow back more woody and more aggressive. Timing important. Must generally repeat treatment. Labour-intensive. Costly.
Tillage/seeding	Can use near water. No permit. Establish preferred species. Destroys underground roots.	Repeat treatment usually required. Labour-intensive. Costly. Dry soil conditions required. Best suited to agricultural settings or heavily infested grassland.
Burning	May destroy seeds. Can be selective (propane torch). Mimics natural processes.	Public relations (smoke). Timing limited. Seeds in the soil unaffected. Re-vegetation may be necessary. Does not kill underground roots.
Herbicide use	No soil disturbance. Kills roots. If residual, will affect seed bank and emerging plants. Can be selective.	Limitations near water. Public perception. Timing important. Must generally repeat treatment (long-term cost). Permits and regulations.
Biological control	Cost-effective. Self-perpetuating. Self-dispersing. Long-term. Many successful bioagents available.	Takes time to establish. Not effective in all habitats. Does not eradicate weeds. Target weed often replaced by new species.
No action	None	Infestation will spread (unless at range limit). Long-term costs and environmental degradation.

Source: Seven steps to managing your weeds: A manual for integrated weed management in British Columbia (2002) BC Ministry of Agriculture and Lands and Open Learning Agency

Herbicides should only be used as a last resort. They will be specifically formulated for particular weeds so when selecting an herbicide be sure to explain to the retailer what the dominant weed species on your property are. Some things to consider when spraying include: growth stage of the weed, herbicide mode of action and proximity to watercourses and groundwater wells.

Helpful tips to prevent weeds:

- **Promote the growth of desirable pasture plants to out-compete weed species**
- **Do not overgraze pastures (5 cm is the minimum height) especially in winter and early spring**
- **Buy certified weed-seed-free hay**
- **Mow pastures regularly before weeds go to seed and to maintain a uniform grass growth**
- **Identify weeds early and manage them appropriately**
- **Plant native plants black hawthorn (Crataegus douglasii), red-osier dogwood (Cornus stolonifera and indian plum (Oemleria cerasiformis) as field borders to prevent weed seed colonization**

Prevention

The key to effectively managing weeds is to prevent them from growing in the first place. By educating yourself on weed species and their associated management you can prevent infestations from occurring at all.

C. Soil Analysis

i. Why should I test my soil?

Soil quality is very important. Plants get all of the nutrients they need for growth from the soil. In order to effectively manage your pastures you need to know certain soil characteristics such as: pH, organic matter, nitrogen (N), phosphorous (P), potassium (K), calcium, (Ca), magnesium (Mg), certain micronutrients, salinity and texture. If you know the ratios of these things then it is much easier to determine application rates of materials such as lime and compost. The following is a list of some of the larger soil testing labs in BC.

Bodycote Laboratories
#104, 19575 – 56A Avenue
Surrey, BC
V3S 8P8
Phone: 604-514-3322 or 800-889-1433
Website: http://www.bodycotetesting.com

M&B Research & Development
2062 West Henry Avenue
Sidney, BC
Phone: 250-656-1334
Fax: 250-656-0443
Website: http://www.mblabs.com

Pacific Soil Analysis Unit
#5, 11720 Voyageur Way
Richmond, BC
V6X 3G9
Phone: 604-273-8226

Soilcon Laboratories
275 – 11780 River Road
Richmond, BC
Phone: 604-278-5535

ii. How do I sample my soil?

Each lab will have slightly different soil sampling techniques so it is best to check with them first. However, there are some general guidelines that most labs follow that you will be expected to carry out. These include:

- Try to get 20 to 30 samples from each different soil type within each field and collect samples from the same crop cover separately (i.e. pasture vs. hay fields).
- Do not use rusty tools to collect samples as they can contaminate the sample with iron
- Collect samples from at least 3 different depths (0-15 cm, 15-30 cm, and 30-60 cm)
- Mix similar samples in a plastic pail to prevent metal contamination and mix thoroughly to break up any clumps
- Package, label and submit the samples – 0.5 kg per clean plastic bag (separate samples for each soil type and depth and label accordingly)

D. Spreading Soil Amendments

Before spreading composted manure onto your pastures it is in your best interest to sample and test these as well. Testing the manure for total nitrogen (N), phosphorus (P), potassium (K), ammonium- (NH_4^+-N) and moisture content will allow you to accurately match the manure application with the pasture needs.

There are a number of benefits to spreading manure compost when compared to raw manure. Nitrogen in composted manure is in an organic form, which is released gradually into the pasture soil. This decreases the risk

of immediate leaching and extends the availability of N throughout the growing season. Also, most plant nutrients in compost are not immediately soluble in water and are released gradually.

Some of the other benefits of adding compost to pastures include:
- Increased water infiltration
- Increased water-holding capacity
- Increased moisture content
- Increased aeration and permeability
- Increased soil aggregation and rooting depth
- Decreased soil crusting
- Decreased soil bulk density
- Decreased runoff by erosion

i. How do I sample my manure for testing?

Before sampling your manure compost make sure that you check with your local soil lab to see if they have special sampling guidelines that you should follow. According to the Ministry of Agriculture and Lands, you should obtain a representative sample by collecting from 6 to 8 different locations within your manure pile. Make sure that you take samples from both the exterior and the interior of the pile. Next, thoroughly mix the manure samples to break up any clumps and combine them well. Collect a minimum of 3 sub-samples from your representative sample and label well. Ideally, the samples should be analyzed within 24 hours of collection.

ii. How do I calculate manure spreading rates?

It is important to identify the appropriate spreading rates for your pastures. An over-application of compost can lead to leaching and surface or groundwater pollution, while too little can reduce pasture growth. Application rates are based on: (1) nutrients required by the plant for optimum growth, (2) nutrients present in the soil, and (3) nutrients available in the compost. The application rate will also depend on field topography, climatic region and soil type so these should be taken into account when spreading. According to the BC Ministry of Agriculture and Lands, manure or a manure/bedding mixture from 3 to 4 horses can be spread on each acre of productive pasture on your land. Manure compost should also be spread in several applications throughout the growing season from April to September, but not from October to April.

Average fertilizer content in horse manure (as-is basis)	
N/ton	8.6 kg (19 lb)
P2O5/ton	6.4 kg (14 lb)
K2O/ton	16.3 kg (36 lb)

Source: Horse Manure Management (2004), Colorado State, University Cooperative Extension, J.G. Davis and A.M. Swinker

Most soil and manure testing labs will supply crop requirement information and application rates in easy to read formats. Once you determine the needs of your pasture grasses the following example calculation will help you determine the appropriate compost spreading rates for your land.

iii. How do I spread compost?

Manure compost is an excellent source of nutrients for your pasture grasses. Chemical fertilizers can easily leach into surface water or groundwater and the nutrients are only available immediately after the application. When using composted manure, nutrients are released gradually, allowing them to be used more efficiently by the plants on an on-demand basis. This can therefore reduce the amount of fertilizer needed and prevent leaching.

When spreading manure compost it is important to remember that it should only be spread during the growing season from April to September. Up to 1/3 of fall and winter applied nitrogen in manure may be lost by denitrification, volatilization, leaching and surface runoff during the spring thaw. Only apply a ¼ inch of compost at a time and no more than 3 to 4 applications per year. Reapplication should only occur when the previous layer has worked its way into the soil. For this reason good record keeping is important.

Spreading composted manure is far more beneficial than spreading raw manure for a number of reasons as laid out in the waste management chapter (see section B: Manure Composting). Since composted manure is lighter

Example for calculating compost application rates (BC Ministry of Ag and Food – 1996)

Determine: Compost application rate to supplying 200 kg of N. Given the following compost analysis,which can be obtained through a soil analysis:

Total N	(TKN) 1.59% (or 15,900 ppm)
Mineral N	Ammonia (NH4) 1562 ppm
Nitrate	(NO3) 672 ppm

Bulk density of compost is 400 kg/m3

Assume: 50% loss of ammonia (NH4-N) (based on research with manures, composts and biosolids)
20% of organic N is available in year of application (based on a range of 10 to 30% from research on composts and biosolids)

Calculation: Total available N in the first year is: available organic + remaining ammonia + nitrate
Total organic N = (TKN - NH4) = 15,900 ppm - 1562 ppm = 13,666 ppm
Available organic N = 13,666 ppm x 20% = 2733 ppm
Remaining NH4 = 1562 x 50% = 781 ppm
Nitrate (NO3) = 672 ppm
Total available N = 2733 ppm + 781 ppm + 672 ppm = 4186 ppm (or 4.18 kg/tonne)

To obtain 200 kg N per ha apply 47.8 tonnes compost per hectare (200 kg N/ha / 4.18 kg N/t) or 47.8 tonnes/ha x 1000 kg/tonne x 1 m3/400 kg = 120 m3/ha

Answer: Therefore, 120 m3/ha of compost can be applied to supply the 200 kg N/ha.borders to prevent weed seed colonization

and more uniform than raw manure it is easier to spread. However, there may be some clumping so it is important to harrow or cultivate your pasture after spreading. Seeding can take place shortly after spreading as compost provides a great medium for seed germination.

iv. Why should I lime my pastures?

In regions where there is acidic soil, such as in the Lower Mainland, liming can help prevent pasture management problems. Weed species such as creeping buttercup and field horsetail thrive in acidic, wet soil and can be managed by controlling the pH in your pastures. Lime is a very basic material and will raise the soil pH to a more alkaline level (above pH 7). Also, liming can help grass out-compete weed species by allowing the right conditions for efficient nutrient absorption. In acidic regions the soil is often limiting in magnesium (Mg), which can affect pasture grass growth. Lime products, such as dolomite lime, contain Mg that can help balance the soil profile. There are companies that sell agricultural lime and often provide their services in application. Check your local yellow pages for a list of companies that supply soil amendments.

E. Seed Mixes and Forage Quality

i. What seed mixes should I use for my horse pastures?

The key to choosing seed mixes for your horse pasture is diversity. The different species in your grass mix will be able to grow in their respective microclimates within your pastures and will lead to lower vulnerability to disease and pests. However, it is still important to tailor your grass mix to the type of soil on your property and the expected use (i.e. grazing, sacrifice area or hay). Mention the topography in your pastures to your seed retailer so that they can help identify the appropriate mix specifically for you. It is beneficial to include a legume (i.e. clover) into your seed mix as these are very high in protein and minerals and help to fix nitrogen in pastures. However, be careful if your horses are pre-disposed to laminitis or Cushing's disease as a high protein content can be detrimental.

The best time to broadcast overseed (spread seed over already established grasses) your pastures is in late September to early October after you have spread your manure compost. Seeding rates will vary depending on the grass species so check with your retailer before seeding.

There are many different grass species that will work for horse pastures, but they are highly dependent on the field use and the soil conditions. The following table outlines some grass species and the growing conditions that are well suited to their variety.

Tall fescue can tolerate acidic soil with low fertility and can withstand damage from horse hooves, while perennial ryegrass establishes quickly and is highly palatable. If using a mixture of these two species then 2/3 should be tall fescue and only 1/3 perennial ryegrass. In the interior perennial ryegrass can act like an annual, therefore, grass options for this region include bluegrasses, creeping red fescue, orchardgrasses, wheatgrasses and alfalfa.

Agricultural Waste Control Regulation

Section 13 – Agricultural waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater.

Section 14 – Agricultural wastes must not be applied

(a) on frozen land
(b) in diverting winds
(c) on areas having standing water
(d) on saturated soils, or
(e) at rates of application that exceed the amount required for crop growth if runoff or escape of agricultural waste causes pollution of a watercourse or groundwater, or goes beyond the farm boundary.

Soil type	Grazing only* or grazing and hay	Exercise area*
Well-drained	Tall fescue	Bentgrass
	Orchardgrass	Fine fescue
	Perennial ryegrass	Tall fescue
Somewhat poorly drained	Tall fescue	Fine fescue
	Perennial ryegrass	Tall fescue
*Pasture grasses should always be "endophyte-free"		

Source: Managing Small-acreage Horse Farms: For Green Pastures, Clean Water, and Healthy Horses (2003) Oregon State University Extension Service

ii. What forage species should I avoid?

There are a few grass species that horse owners should avoid. These include endophyte-infected tall fescue, alsike clover and Kentucky bluegrass. Endophyte-infected tall fescue contains a fungus that lives inside the plant and produces mycotoxins. These mycotoxins can be harmful to pregnant mares by causing prolonged gestation, stillborn foals, retained placentas, reduced or absent milk production and difficulty in rebreeding. The mycotoxins can also be present in tall fescue hay, but the effects in hay can be somewhat diluted by feeding other forages at the same time.

Alsike clover is associated with the occurrence of photosensitization and/or liver damage. Some horses are more sensitive than others and the amount needed to cause harm is unknown. The symptoms of toxicity include a sunburned appearance in light-skinned areas of the horse (i.e. face, muzzle and legs), disrupted liver function and jaundice. Alsike clover can be naturally present in pastures, so it is important to educate yourself on its identification. Additionally, grass species such as Kentucky bluegrass can be susceptible to fungal diseases, which is another reason to include a diverse pasture grass mix.

F. Grazing Management

Appropriate grazing management strategies can substantially increase pasture productivity and decrease pasture management costs. Before allowing horses or other livestock onto the pasture to graze you should allow the pasture grass to reach a height of 15 to 20 cm (6 to 8 in) and remove them when they have grazed down to 8 to 10 cm (3 to 4 in). This will ensure that the grasses have enough food reserves to permit rapid re-growth. Re-growth can take up to 2 to 6 weeks, depending on the time of year, so it is important to keep animals off wet, overgrazed pastures. Wet pastures can also lead to health problems such as foot rot and parasite infestation.

i. How many horses can my pasture support?

The general rule of thumb for pasture carrying capacity is approximately 1 horse per acre. This will, of course, be a much smaller area for miniature horses and care must be taken as minis are generally easy keepers and can suffer from laminitis much more readily. The total land available for grazing on your property can be calculated by totaling what is left after excluding land for buildings, barns, trees, driveways, landscaping and watercourses/riparian areas.

Soil and climate characteristics will also play a role in available pasture as the number of horses should be reduced or eliminated in times of drought or heavy rainfall. Finally, the physiological state of your horse(s) will determine how much they graze as lactating mares with foals or draft horses will require more forage than mature geldings.

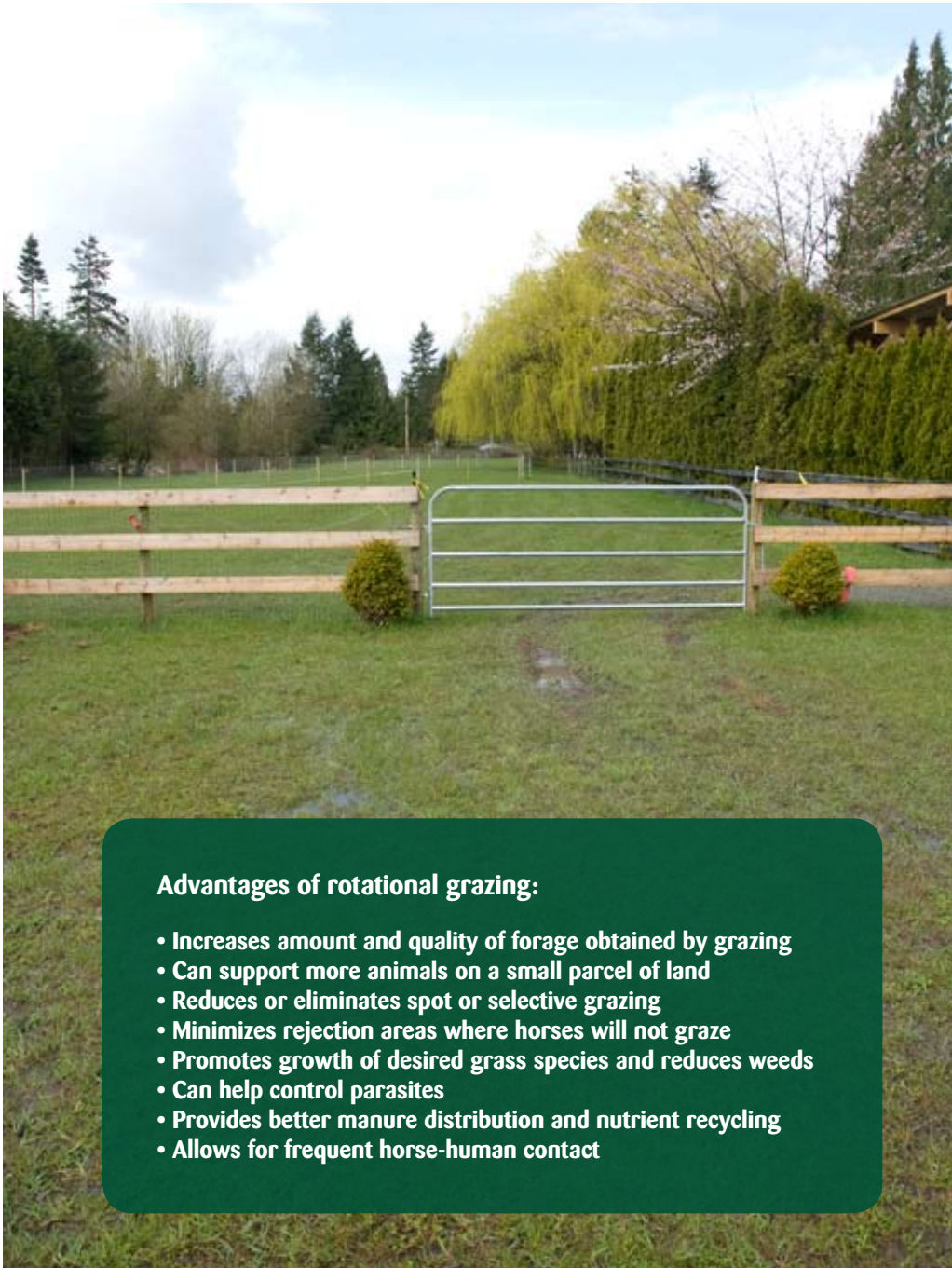
ii. How should I graze my pastures?

Rotational or limited grazing can maximize pasture grass when it is in short supply. Rotational grazing involves breaking larger pastures up into smaller sections and only grazing one section at a time to allow the other areas to regenerate. This encourages even grazing of pastures as well as many other benefits such as:

- Increased amount and quality of forage
- Increased growth of desired grass species and reduced weeds
- Better parasite control
- Better manure distribution and nutrient recycling
- More frequent horse-human contact

If you decide to implement rotational grazing then it is best to start by dividing a large pasture in two and grazing each of these separately. You can then divide further later on. Ideally it is best to have 4 pastures that provide enough grazing for 7 to 10 days as this gives each pasture a rest for 3 to 5 weeks. To divide pastures you can use electric fencing or tape at a height of approximately 90 cm (3 feet) or chest height of your livestock. This is a relatively inexpensive method that has proven to be highly successful. It is important to remember that you will need to monitor pasture growth at different times of the year and rotate accordingly.

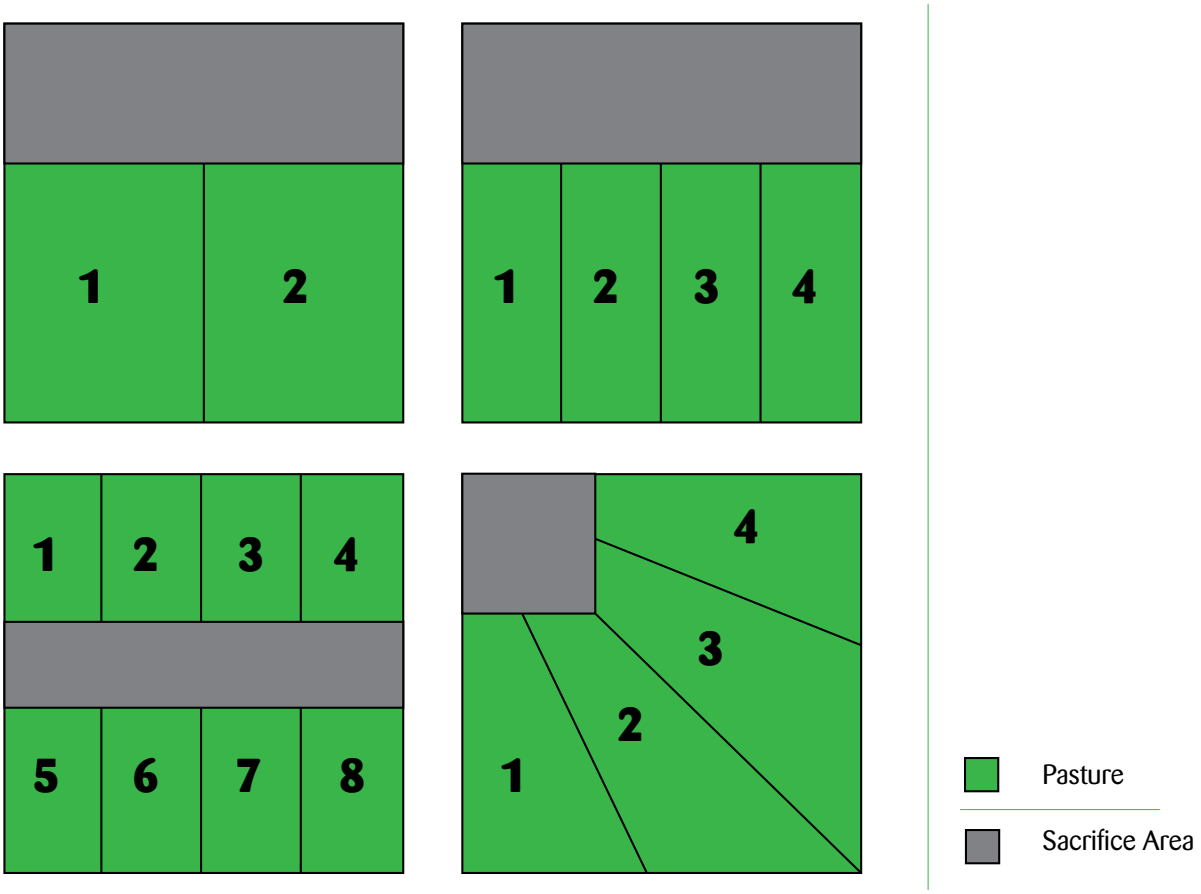
Limited grazing can have the same benefits as rotational grazing and involves turning your animals out for limited periods of time (once or twice a day, before or after work, for a few hours at a time). More supplemental feeding will be required and grass height will need to be monitored. Grazing muzzles can also be used in order to allow your horses to have access to pastures without overgrazing them.



Advantages of rotational grazing:

- **Increases amount and quality of forage obtained by grazing**
- **Can support more animals on a small parcel of land**
- **Reduces or eliminates spot or selective grazing**
- **Minimizes rejection areas where horses will not graze**
- **Promotes growth of desired grass species and reduces weeds**
- **Can help control parasites**
- **Provides better manure distribution and nutrient recycling**
- **Allows for frequent horse-human contact**

Rotational Grazing Possibilities



iii. What is a "sacrifice area"?

A sacrifice area is a small enclosure such as a paddock, corral, pen or turnout area that is meant to be a place for your horses to go when pastures are too wet or you want to limit grazing. It is called a sacrifice area because you are sacrificing this area for the benefit of your pastures. These are beneficial for a number of reasons such as protection from overuse of pastures, over-consumption of lush grass in the spring and early summer, use as a central watering and a feeding location for rotational grazing systems. They can also be useful when you need to care for sick or injured animals.

There are numerous reasons to keep your animals off wet pastures. Pasture grasses can be killed and mud can be created through trampling and churning of the soil. Also, large animals can compact the soil, which kills plant roots and reduces drainage. This causes further vulnerability of your pastures to weed growth, soil runoff and erosion. Since a sacrifice area provides a place for your animals to live during wet times of the year it is important that it be on high, dry ground with good footing material such as dry hog fuel, crushed rock or sand. There should also be a buffer around the perimeter to prevent runoff. The suggested size for a sacrifice area is approximately 100 m2 (1000 ft2) for one horse.

Agricultural Waste Control Regulation

Section 28 – Livestock, poultry or farmed game in a confined livestock area may not have access to a watercourse, with the exception of a holding area on rangeland where

(a) livestock is held no longer than 72 hours,
(b) the watercourse is not a source of water used for domestic purposes at any location downstream from the confined livestock area, and
(c) the access is located and maintained as necessary to prevent pollution

Section 29 (1) – Confined livestock areas must be operated in a way that does not cause pollution.

Section 29 (2) – If there are more than 10 agricultural units in a confined livestock area or areas within the same drainage basin then the areas must be located at least 30 m from a high tide watermark, a watercourse, the bank of a watercourse or any source of water used for domestic purposes.

Sacrifice areas are a great place to keep your horses during wet times of the year.

Water Management

Managing water on your property is very important for a variety of reasons. It is vital that you maintain clean drinking water for yourself and your horses by keeping manure piles and any chemical substances a safe distance from wells and domestic water sources. Also, keeping streams and drainage ditches clean will help sustain habitat for fish and aquatic organisms.

When managing our animals we need to take into account surface water such as creeks, ditches, streams, swamps and wetlands, as well as groundwater. Potential pollutants include nitrogen, chemicals and bacteria, which can come from animal manure or chemical sources. Keeping animals out of streams, locating manure piles at a safe distance, and properly storing agrochemicals will help prevent any pollution problems.

A. The Watershed

i. What is a watershed?

A 'watershed' is an area of land that catches rain and snow and drains it into waterways and is defined by the height of the land and the surrounding topography. The collected water is received as precipitation, which then drains or seeps into surface water (i.e. streams, creeks, ditches, swamps and wetlands) or groundwater. This water then flows into nearby rivers and out into the ocean or lake. Thus, even if your property is not located near a stream or lake your management practices can still have an effect on water quality through groundwater or drainage ditches. Watercourses can undergo seasonal changes; even if there is no water in the stream on your property in the summer months, you may have valuable aquatic habitat during the wet months of the year.

Landowners have a responsibility to manage the quality of the water that leaves their property. Excess nitrogen in the form of manure and woodwaste leachate can cause algal blooms and the growth of aquatic vegetation, which use up oxygen as they decompose. Fish and many other aquatic organisms breathe dissolved oxygen and require it to survive. The Ministry of Agriculture and Lands has found that excess nitrates leaching into groundwater can cause health problems for humans as well, such as blue baby syndrome, cancer and other birth defects. Other health concerns arise when bacteria and fecal coliforms infect streams through fecal transmission (i.e. manure).

You can determine which watershed you live in by checking the Watershed Code Availability Maps through Environment Canada. The website address is: http://www.env.gov.bc.ca/fish/watershed_atlas_maps/maps/watershed.html. Identifying where the watercourses run in your watershed will help you to make appropriate water management decisions.

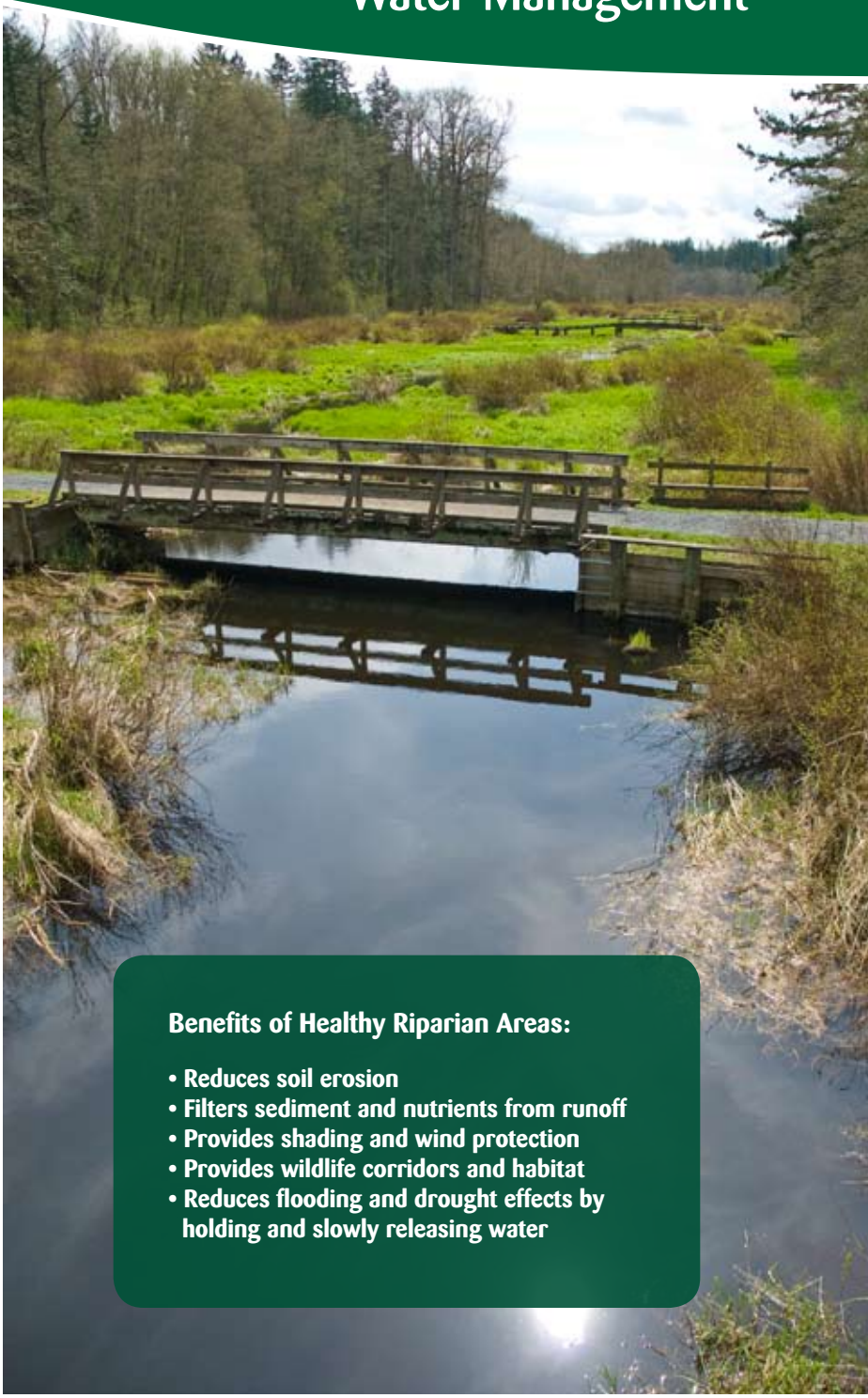
B. Riparian Management

i. What is a riparian area?

The 'riparian area' refers to the land immediately surrounding or adjacent to a waterway and other surface water. Ideally, the riparian area should contain a diversity of indigenous trees and shrubs. Vegetated riparian areas support a very high level of biodiversity, yet are also highly susceptible to trampling by horses and cattle. Riparian areas serve many important functions as windbreaks, wildlife corridors, nesting and denning habitats, filtration for runoff, shade and protection and provide food supplies. They can also produce more forage than upland areas because the water availability supports increased plant growth and diversity. Therefore, it is very important that we take responsibility for our animals and prevent them from trampling riparian areas and keep their manure on high, level ground far from the watercourses.

ii. How do I manage my riparian area?

There are some signs that you can look for that indicate damage to riparian areas. The first sign is the reduction in the number of saplings (i.e. young trees or shrubs) and the reduction in plant height. Another sign is the evidence of pugging (hoof tracks left in the soft soil) or hummocking (soil that has been pushed up by pugging due to trampling near the watercourse). Finally, the evidence of manure or urine in watercourses could lead to riparian area damage. Many farmers use creeks and streams for their animals' water needs, however, this can cause serious damage and has environmental implications as explained above.



Benefits of Healthy Riparian Areas:

- **Reduces soil erosion**
- **Filters sediment and nutrients from runoff**
- **Provides shading and wind protection**
- **Provides wildlife corridors and habitat**
- **Reduces flooding and drought effects by holding and slowly releasing water**

There are many riparian management tips that can be followed to eliminate detrimental impact on riparian habitat. Using alternative watering sources will reduce trampling of vegetation and pugging of the soil. Also, providing salt, mineral and supplemental feeds away from riparian areas will reduce the risk of water contamination. Finally, fencing off the riparian area completely with either permanent or temporary fencing, such as electrical tape, will provide a vegetative buffer and a natural filter for pasture runoff.

Buffer strips can also protect land from erosion if the area is prone to flooding. Grass plants tend to have shallow roots, which do not provide the same level of stability as a well-vegetated riparian area. When erosion occurs in areas such as these it can result in a significant loss of land of up to one metre per year. One way to tackle this is by providing limited access points with better footing (i.e. gravel) in order to avoid soil erosion and compaction. It is also desirable to maintain stands of trees or provide shade (i.e. a roofed shelter) beyond the riparian zone to draw livestock away from sensitive areas.

C. Livestock Management

i. What types of watering systems are available?

One of the best methods to control watercourse contamination is to provide animals with a sufficient watering system for their needs. There are a variety of different systems including solar powered pumps, sling pumps (water current powered), water harvesting pumps (from rainwater collectors), nose pumps and gravity fed systems. All of these limit the need for electrical power.

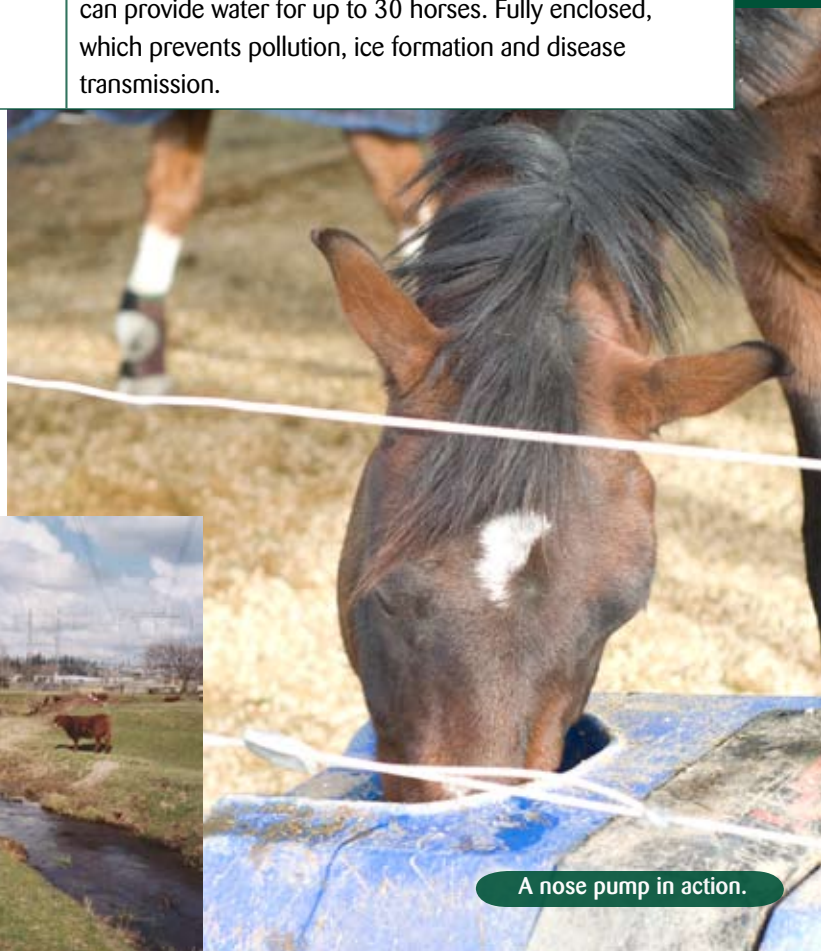
4 good reasons to restrict livestock access to riparian areas:

- **Prevents drowning during periods of high flow**
- **Prevents foot rot due to less loitering in muddy streams**
- **Maintains healthy water quality for aquatic organisms and livestock**
- **Prevents erosion by protecting stream banks from pugging**

Type of Pump	Source of Energy	Comments
Solar Powered Pumps	Photovoltaic solar panels	Solar panels convert sunlight to DC electricity, which operates the pump and delivers water to livestock watering systems.
Sling Pumps (or Flow of Stream Pumps)	Water current	Continuous pumping action during a 24-hour period compensates for slow flow rates. Water storage may be required to meet the full needs at certain times throughout the year.
Water Harvesting Systems	Stored rainwater	Utilizes storm water runoff. Must be filtered to meet drinking water standards.
Gravity-Fed Pumps (or Flow-Through Livestock Waterers)	Gravity-pressured water supply	Constant flow of water prevents the formation of ice. Can be some water waste. Water should be stopped when not required by animals and outflow contained.
Nose Pumps	Diaphragm pump	Animal pushes a lever with its nose and delivers about one litre of water. Water can be lifted up to 8 metres. One pump can provide water for up to 30 horses. Fully enclosed, which prevents pollution, ice formation and disease transmission.

Once you have determined the appropriate watering system for your animals' needs you will need to find a good location for it. Some of the things to keep in mind are:

- Locate the watering system at least 30 m away from watercourses and wells
- Situate the system away from feeding areas to encourage manure distribution
- Provide a firm base (concrete or rubber mats) around watering area to prevent muddy soil conditions
- Ensure adequate drainage for spillage and overflow
- Check system for leaks regularly and other mechanical performance



A nose pump in action.

Agricultural Waste Control Regulation

Section 7 (1) – A storage facility must be located at least 15 m from any watercourse and 30 m from any source of water for domestic purposes

Section 13 – Agricultural waste must not be applied to the land if, due to meteorological, topographical or soil conditions or the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater.

Section 14 – Agricultural wastes must not be applied
(a) on frozen land
(b) in diverting winds
(c) on areas having standing water
(d) on saturated soils, or
(e) at rates of application that exceed the amount required for crop growth
if runoff or escape of agricultural waste causes pollution of a watercourse or groundwater, or goes beyond the farm boundary.

Section 21 – Wood waste stored and used on a farm must be handled so as to prevent any escape of
(a) particulate or solid matter from the wood waste into the air, or
(b) particulate or solid matter or leachate from the wood waste into any watercourse or groundwater that causes pollution.

Section 26 (2) – Locations for feeding livestock, poultry or farmed game within a seasonal feeding area, including locations for movable feed bunks, must
(a) be at least 30 m from a high tide watermark, a watercourse or the bank of a watercourse, unless written permission has been obtained from a director for a closer location.

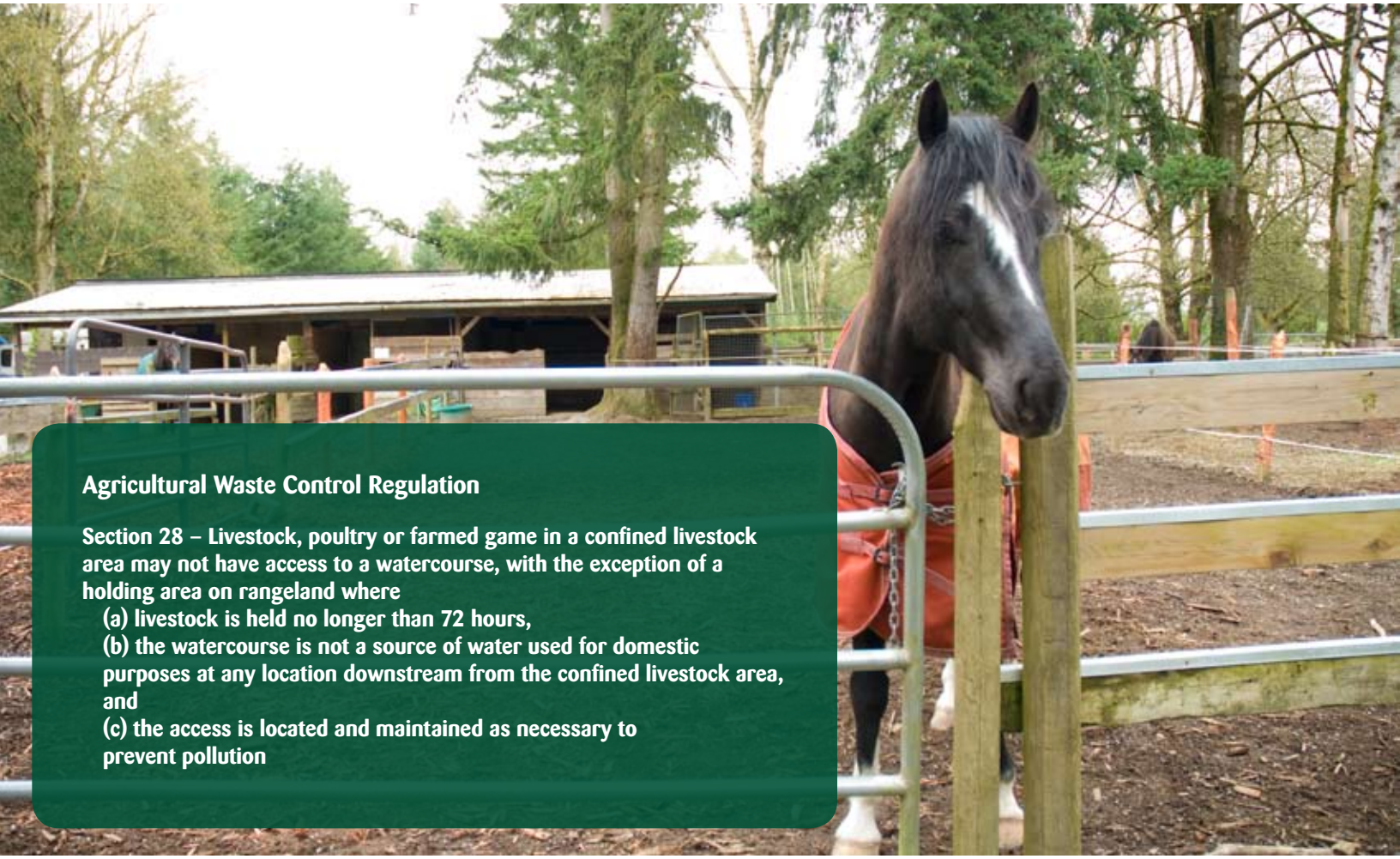
Section 29 (2) – If there are more than 10 agricultural units in a confined livestock area or areas within the same drainage basin then the areas must be located at least 30 m from a high tide watermark, a watercourse, the bank of a watercourse or any source of water used for domestic purposes.

The Code defines “watercourse” to include drainage ditches that flow into surface water such as a lake, river, creek, canal, etc.

Forest Practices Code of BC Act

This Act has conditions under the Range Practices Regulations:

Section 7 (4) – requires dead livestock within 100 m of a watercourse in a community watershed be removed within 24 hours.



Agricultural Waste Control Regulation

Section 28 – Livestock, poultry or farmed game in a confined livestock area may not have access to a watercourse, with the exception of a holding area on rangeland where

(a) livestock is held no longer than 72 hours,

(b) the watercourse is not a source of water used for domestic purposes at any location downstream from the confined livestock area, and

(c) the access is located and maintained as necessary to prevent pollution

ii. How should water be managed in a confined livestock area?

Confined livestock areas include feedlots, paddocks, corrals, exercise yards and holding areas. Generally the regulations state that these must be at least 30 m from the high water mark from any watercourse or wetland and livestock may not have access to any natural watercourses or riparian areas. Any contaminated runoff from a confined livestock area must be contained and managed as manure. To prevent pollution, this runoff also must not reach ground or surface water and should be diverted away from livestock areas.

iii. How should water be managed in a seasonal feeding area?

Seasonal feeding areas are locations that support livestock feeding operations for part of the year and may produce a crop. Similar to confined livestock areas, any runoff in these locations must be managed as manure. Livestock waterers, such as nose pumps, are encouraged in these regions. Animals may have access to natural watercourses from seasonal feeding areas; however, this must be in locations where access has already been established.

Bridges are a great way for livestock to cross streams.

iv. How can I feed our animals to limit water pollution?

Proper grazing and feeding management of your animals can help to protect watercourses and riparian habitat. Practices such as controlled grazing in riparian zones can prevent streambank damage in wet weather and maintain vegetation. Also, locating feeding sites where the ground slopes away from the watercourse and at least 30 m from waterways and wetlands will further prevent damage. You can also move livestock feed and supplements around the pasture to evenly distribute manure and reduce loitering near streambanks. If you want to eliminate your animals' access to watercourses completely then you can utilize electric fencing around riparian zones.

The runoff from feed storage sites can contain large amounts of nutrients and organic matter, which can contaminate watercourses and deplete the oxygen content in the water. Therefore, these should be located far from

4 good reasons to keep manure out of water:

- **Prevents the spread of pathogens to other livestock, farms and people**
- **Prevents water contamination and unpalatable water sources**
- **Prevents algal growth, which depletes the water of oxygen**
- **Prevents ammonia contamination in watercourses**

watercourses. Also, seepage from silage storage should be handled with manure where possible as it can have the same result.

D. Storm Water Management

i. Why should I manage my storm water?

Storm water management is important in areas with high rainfall, such as the BC coast. Barn, house and other building roofs can collect large volumes of muddy water that can run off to the ground. One inch of rain on a 20 ft by 50 ft barn roof can produce 2347 litres (620 gallons) of water, which is the equivalent to one and a half average-sized hot tubs. This water should be directed away from high use areas in order to reduce mud. Mud can cause a multitude of health problems such as foot rot and thrush. Plastic pipes can be used to direct water away from animal confinement areas to places that are more easily drained. This water can also be contained in rain barrels where it can be later used in times of drought.

When land drainage is a serious concern, such as in areas with clay soils, other management tips are available. Drainage management features can be installed, such as French drain lines or drainage tiles. Grassed waterways, water bars, ditches and dry wells can also be created to prevent water pooling. Planting native trees and shrubs or other water-loving species, such as willow, cottonwood and red-osier dogwood, can help to 'soak' up some of the water runoff and prevent siltation and contamination of nearby watercourses. If browsing by animals is a concern these native plants can be fenced in.

E. Groundwater Protection

i. Why should I protect groundwater?

'Groundwater' refers to the water that infiltrates through the ground and accumulates in underground water bodies called aquifers. Groundwater can resurface in wetlands and floodplains as springs and percolate into streams be or pumped by wells to the surface. If this water becomes contaminated by pollutants such as manure or agrochemicals it can take decades or even centuries to be replaced in an aquifer. Many landowners depend on this water for drinking purposes so it is important to ensure that it remains clean. The potential for groundwater to be contaminated depends on a number of soil characteristics such as texture, temperature and organic content.

Tips for maintaining water quality downstream:

- **Install rain gutters and roof runoff systems on barns and covered arenas**
- **Create diversion berms to divert storm runoff around corrals and other confinement areas**
- **Create catch basins for contaminated runoff**

Health Act

This Act has requirements under the Sanitary Regulations:

Section 9 – prohibits accumulation or discharge of wastes that endanger the public health

Section 42 – provides separation distance from wells to be at least 30.5 m from any probable source of contamination (probably source of contamination could include fertilizers, compost materials, and leachate) and 122 m from any cemetery or dumping ground (cemetery could include buried mortalities)

Section 43 – prohibits contamination of any domestic water supply

Drinking Water Protection Act

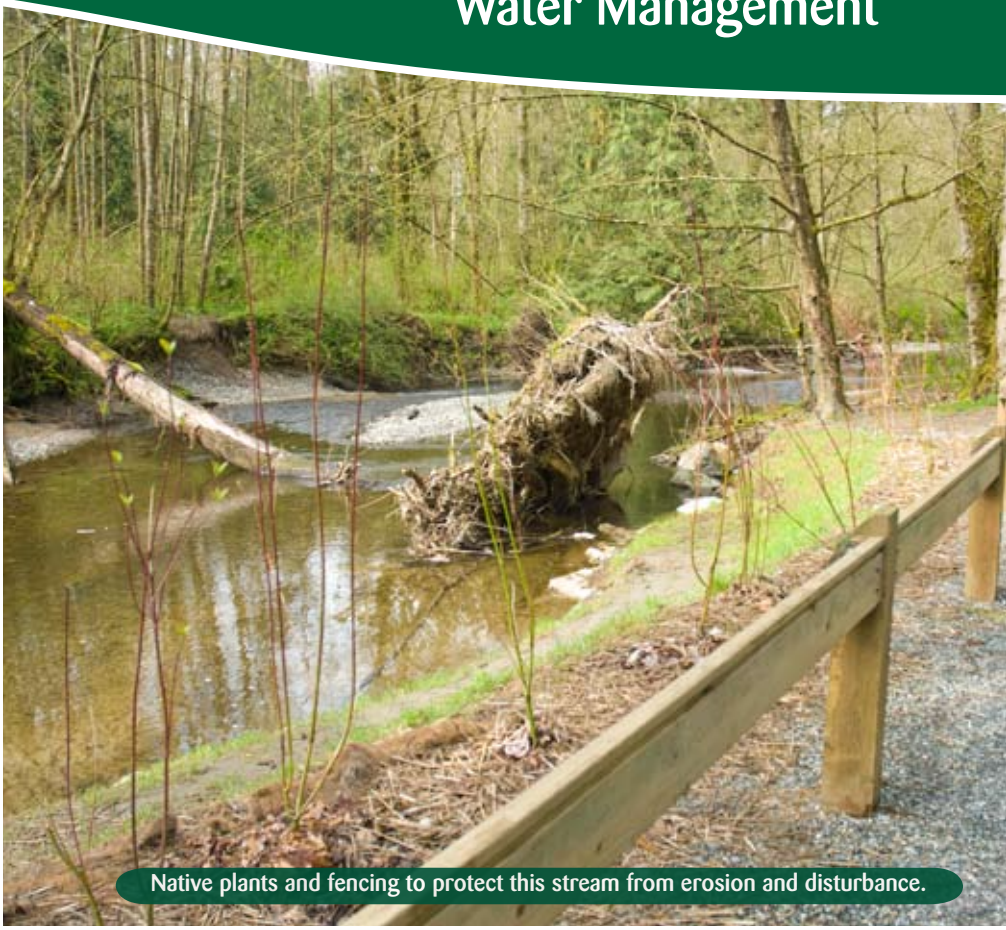
This act prohibits introducing, causing or allowing anything that will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

The Drinking Water Protection Regulation defines potable water as:

- **no detectable fecal coliform bacteria per 100 ml**
- **no detectable Escherichia coli per 100 ml**
- **no detectable fecal coliform bacteria per 100 ml for a single sample in 30 days**
- **at least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml for more than one sample in 30 days**

To safeguard groundwater against pollution there are a number of ways you can protect it.

- Determine where your well is in relation to your manure pile, grazing areas, drainfield, etc.
- Keep livestock away from the wellhead – heavy animals can damage the drainfield by compacting soils and damaging buried pipes.
- Divert surface water away from the wellhead.
- Locate your manure pile at least 30 m away and downhill from the wellhead.
- Test well water annually for fecal coliform bacteria and nitrates.
- Avoid leaving hoses immersed in contaminated stock tanks to prevent backflow
- Fence off the septic field area to avoid the spread of disease by grazing livestock



Native plants and fencing to protect this stream from erosion and disturbance.

F. Soil Erosion Control

i. How do I control soil erosion?

Soil erosion is a serious concern in all areas of the province. Whether you live in a wet climate that suffers from soil runoff or a dry climate where wind dispersal is a concern, soil loss is an issue we all need to deal with. Soil can sluff into watercourses and cause siltation problems. Silt can cloud the water so that fish are unable to see food sources, smother trout and salmon eggs and cover spawning habitat. It is important to note that pollutants often adhere to soil particles as well, which is associated with increased siltation of watercourses.

There are a few ways to minimize these effects through the use of buffer strips, shelterbelts or hedgerows. All of these are buffers that are planted at the edge of pastures to reduce the risk of wind or water runoff. They can also provide potential income if saleable crops such as raspberries or fruit trees are planted. If you are looking for aesthetic benefit then grasses, flowering shrubs and trees, floral plants, and ornamental plants can also be planted. The width of the buffer zone will be dependent on the slope of the field, the soil type and the density of the species you choose to plant. Check with your regional Ministry of Agriculture and Lands office for more information on buffer zone possibilities in your area.

Lack of streamside vegetation can cause severe soil erosion.

Some of the advantages of a buffer zone include:

- Filters mud, manure, pesticides, and bacteria out of water flowing across or through the air
- Improves infiltration of water into the soil
- Provides food and cover for wildlife
- Protects land from erosion caused by water or wind
- Creates an attractive landscape
- Can save on fence installation and repair

G. Chemical Handling and Storage

Manure and agrochemicals are not the only pollutants present on small farms. Animal medical waste and petroleum products are often prevalent and ignored when it comes to land management. The following discussion focuses on safe ways to dispose of these materials and some appropriate management techniques.

i. How do I safely dispose of animal medical waste?

Animal medical waste such as spent medicines, empty medicine containers and other medical items such as syringes and needles must be disposed of in a responsible and safe manner. Often your veterinarian will be willing to accept syringes and old needles (sharps) so check with them before disposing of them yourself. If they aren't able to take them for you then make sure you grind them down or destroy them to eliminate chances of puncture, then package and pack the sharps in a rigid container. Both needles and syringes should also be boiled for 5 minutes or soaked in disinfectant before disposal.

Other medical supplies, medicine bottles and old medication should be taken back to the supplier or pharmacy for disposal as these can have serious consequences on aquatic organisms if they are allowed in the sewage waste stream. Also, used medication should never be added to your manure or compost piles! If the quantity for disposal is in excess of 5 kg or 5 L then contact the Ministry of Environment for correct disposal information.

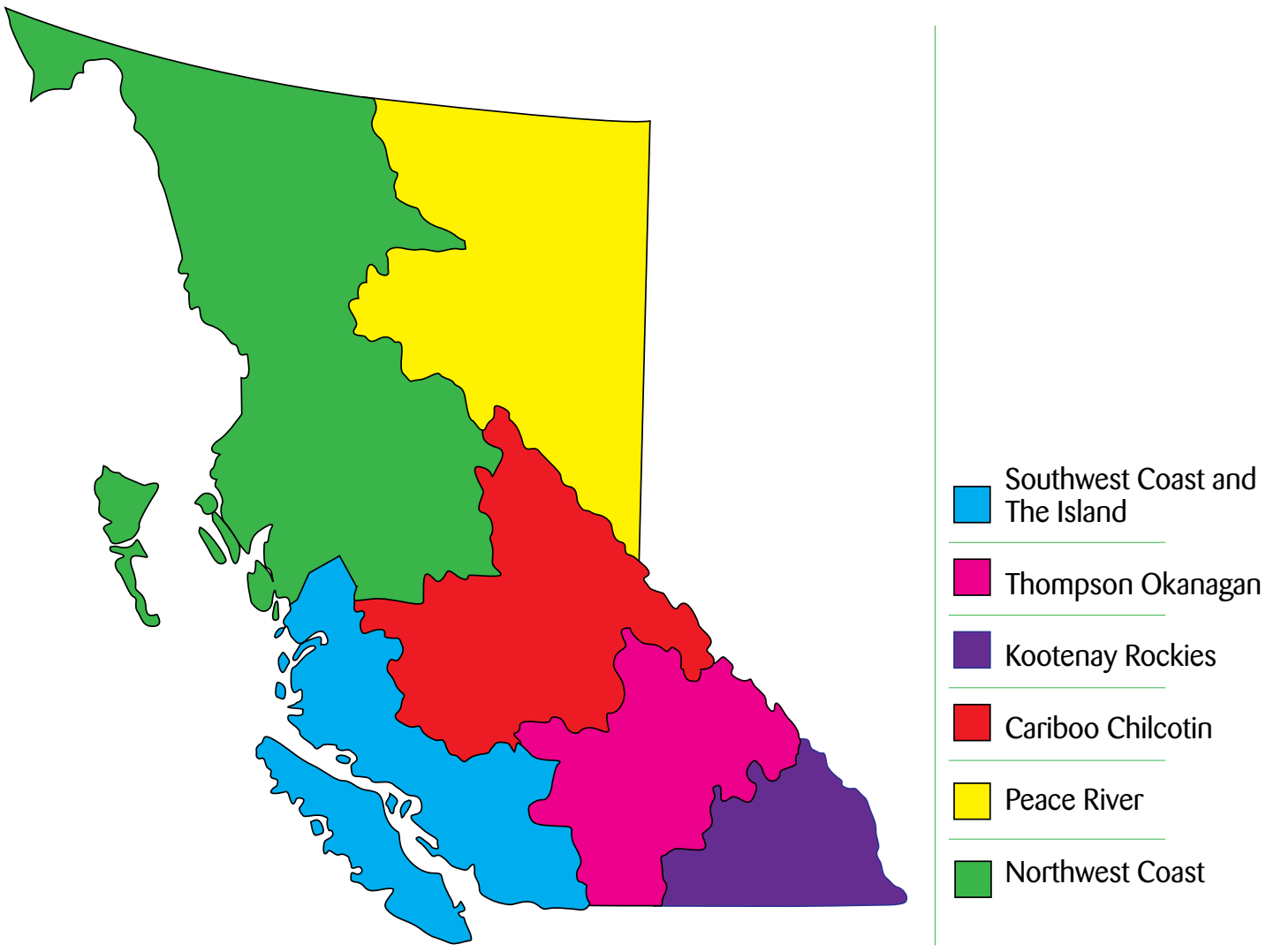
ii. How do I safely use and dispose of petroleum products?

Many farms need to have a source of fuel available on-site; however, fuel tanks should be maintained to avoid any pollution to the surrounding environment. Tanks should be equipped with anti-siphoning devices included in discharge unless there is already a self-closing nozzle. Drains must be lockable and in a closed position at all times if not being used. Drips, leaks and overflow should always be avoided when dispensing fuel and care should be taken when filling the tank to prevent any overflow.

When storage tanks are constructed they must be built with accepted engineering practices and may include a concrete, diked storage area. Tanks should also be located away from yard drains and set back at least 30 m from any watercourse or ditch. Finally, the tank should be well protected from direct collision by farm vehicles. When disposing, all excess petroleum products should be brought to an appropriate hazardous waste facility in your area.

Regional Concerns

Agricultural practices and climatic fluctuations vary widely throughout British Columbia. The amount of rainfall can be less than 300 mm annually in one location, while in other parts of the Province rainfall can be 2500 mm annually. This has a huge impact on waste, pasture, and water management as the different regions need to be managed individually. The following sections provide some additional information for the various regions throughout BC.



A. Southwest Coast and the Islands

This area of the Province generally has heavy precipitation, mild temperatures and long frost-free periods. The greatest amount of rainfall occurs on the outer coast of Vancouver Island with Tofino receiving an annual downpour of 324 cm (127 in). The warm air masses off the ocean are forced up by the Island Mountains, which causes considerable precipitation from September to March. In contrast, the Pacific Ocean around Victoria provides a constant temperature of 10° Celsius (50°F) as the Coast Mountains buffer against westerly winds and cooler winter temperatures. Therefore, the Georgia Basin, which includes the east coast of Vancouver Island, the Gulf Islands, Vancouver and the Sunshine Coast, lies in a rain shadow. There is far less precipitation in this region and more sunshine. The average maximum temperature in Vancouver is 6°C (43°F) in January and 22°C (72°F) in July, and its annual rainfall is less than half of Tofino's.

Waste Management

Since rainfall is high in this region care must be taken to ensure manure piles or bins are covered from October 1st to April 1st. This will eliminate runoff into watercourses and prevent groundwater leaching.

In areas that fall under a rain shadow, consistent watering of the manure pile in the dry summer months will be necessary.

Use alternative bedding to avoid woodwaste leachate from escaping.

Pasture Management

Sacrifice areas should be created in areas with wet pastures during the winter months. This will allow an area for horses to gain some exercise without destroying pasture grasses.

Drainage systems should be installed (either surface, subsurface or both) in pastures with standing water.

Lime pastures at least twice a year in the spring and fall to combat acidity and prevent weeds such as creeping buttercup (Ranunculus repens) and field horsetail (Equisetum arvense) from establishing.

Avoid spreading manures, lime or fertilizers after October to eliminate leaching of nutrients into groundwater or nearby watercourses.

Use a seed mixture that is well suited to poorly drained, wet soils.

Water Management

Control storm water runoff to eliminate mud from developing by installing rain gutters and downspouts on barns and other outbuildings. Mud can cause health problems in horses such as mud fever, hoof abscesses, sand colic and thrush.

Use rain barrels to contain storm water for use on manure piles in dry summer months.

B. Thompson Okanagan

The Interior Plateau on the east side of the Coast Mountains is much drier and more continental than the coast, with a lower humidity. Summers are generally warm and dry, while winters are cool. This area includes the Okanagan, Similkameen and Thompson River Valleys, which experience the hottest summers in BC with temperatures often in the 30°C range (86-102°F) and sometimes above 40°C (104°F). Kamloops has an average maximum of -1°C (30°F) in January and 28°C (82°F) in July, with just 27.9 cm (11 in) of annual precipitation. Further north in the Interior Plateau in regions such as Williams Lake and Prince George the climate is much more moist and cool than in the southern locations. Kelowna, on the contrary, has the most sunshine in BC with 2000 hours annually and an annual rainfall and snowfall of 33 cm (13 in) and 104 cm (41 in), respectively.

Waste Management

When composting manure be sure to keep the pile covered; this will help to retain heat and moisture within the pile.

Water compost pile regularly to maintain the appropriate moisture content. The compost pile should feel like a damp wrung-out sponge when squeezed. This is especially important during dry summer months as moisture will aid in maintaining temperature and preventing a potential fire hazard.

If necessary, install a forced air system with PVC piping and an air compressor underneath the compost. This will force warm air up into the compost and will help speed up the process by keeping the temperature warm during the winter.

In the winter, ensure snow does not come in direct contact with the manure pile. Snow can be a great insulator and should be allowed to fall on the compost, but only on top of a tarp. Direct contact of snow on the compost pile will often cause rapid cooling and slow or cease the composting process.

Pasture Management

Weed species to be aware of in this region include larkspur, alsike clover, water hemlock, burdock, orange hawkweed, hoary alyssum, Canada thistle and knapweed.

The best weed control method in the interior is mowing. Mow pastures after grazing to keep weeds down and maintain dense, even pasture grasses.

In this region of the province the soil is often alkaline; this can be a concern for pasture grass growth. You can decrease the soil pH (and make it more acidic) by using an organic mulch such as manure compost with a higher proportion of bedding. Other organic options are composted maple, beech, chestnut or oak leaves that can be spread on your pastures.

Be careful when choosing seed mixtures for the interior. Some choices for grass seed in the interior are bluegrasses, creeping red fescue, tall fescue, orchardgrass, wheatgrasses, white & red clovers and alfalfa.

Irrigate pastures when necessary, but avoid watering immediately after applying soil amendments or during wet times of the year.

Plant hedge borders or buffer zones to prevent soil erosion by wind dispersal.

Water Management

Efforts need to be made in this region to conserve water as the summers are particularly dry. Install livestock watering systems where appropriate to eliminate contamination of watercourses.

Install rain barrels to capture rain that does fall for use on gardens or compost pile.

C. Kootenay Rockies

This region is located in the far southeast portion of the province. The valley bottoms found in Grand Forks and Cranbrook are semi-arid with warm summers and cold winters. The temperatures in this region range from an average maximum of -3°C (27°F) in January and 26°C (79°F) in July, with 38.3 cm (15 in) of annual precipitation. On the upward slopes in Monashee, Selkirk, Purcell and the Rocky Mountains they experience a much higher precipitation and cooler temperatures. Winter snowfall ranges from 171 cm (67 in) in the south and 206 cm (81 in) in the north throughout the mountain range. The local conditions are mainly affected by altitude, proximity to large lakes, wind flows through the valleys and the rain shadow.

Waste Management

When composting manure be sure to keep the pile covered; this will help to retain heat and moisture within the pile.

Water compost pile regularly to maintain the appropriate moisture content. The compost pile should feel like a damp wrung-out sponge when squeezed. This is especially important during dry summer months as moisture will aid in maintaining temperature and preventing a potential fire hazard.

If necessary, install a forced air system with PVC piping and an air compressor underneath the compost. This will force warm air up into the compost and will help speed up the process by keeping the temperature warm during the winter.

In the winter, ensure snow does not come in direct contact with the manure pile. Snow can be a great insulator and should be allowed to fall on the compost, but only on top of a tarp. Direct contact of snow on the compost pile will often cause rapid cooling and slow or cease the composting process.

Pasture Management

Weed species to be aware of in this region include larkspur, alsike clover, water hemlock, burdock, orange hawkweed, hoary alyssum, Canada thistle and knapweed.

The best weed control method in the interior is mowing. Mow pastures after grazing to keep weeds down and maintain dense, even pasture grasses.

In this region of the province the soil is often alkaline; this can be a concern for pasture grass growth. You can decrease the soil pH (and make it more acidic) by using an organic mulch such as manure compost with a higher proportion of bedding. Other organic options are composted maple, beech, chestnut or oak leaves that can be spread on your pastures.

Be careful when choosing seed mixtures for the interior. Some choices for grass seed in the interior are bluegrasses, creeping red fescue, tall fescue, orchardgrass, wheatgrasses, white & red clovers and alfalfa.

Irrigate pastures when necessary, but avoid watering immediately after applying soil amendments or during wet times of the year.

Plant hedge borders or buffer zones to prevent soil erosion by wind dispersal.

Water Management

Efforts need to be made in this region to conserve water as the summers are particularly dry. Install livestock watering systems where appropriate to eliminate contamination of watercourses.

Install rain barrels to capture rain that does fall for use on gardens or compost pile.

D. Cariboo Chilcotin

The Cariboo Chilcotin region is typically mild, as the Coast Mountains provide a buffer to westerly airflow. Summers are warm and dry while winters are cooler but less moist than in other areas of the Province. There is considerable rainfall from October through February with the majority of the snowfall occurring in the mountain range. The hottest and driest months are July and August while September and October are the fall months with snow falling anytime after mid-November. The temperature range in this region can be quite severe with the occasional -40°C (-12.8°F) in winter to more than 30°C (99.2°F) in summer. The average rainfall ranges between 1677 mm (66 in) in Bella Coola to 539 mm (21.2 in) in Quesnel, while the rainfall in 100 Mile House and Williams Lake is between 386 mm (15.2 in) and 426 mm (16.8 in).

Waste Management

When composting manure be sure to keep the pile covered; this will help to retain heat and moisture within the pile in the colder winter months.

Water compost pile during July and August regularly to maintain the appropriate moisture content. The compost pile should feel like a damp wrung-out sponge when squeezed. This moisture will also aid in maintaining temperature and preventing a potential fire hazard during these summer months.

If necessary, install a forced air system with PVC piping and an air compressor underneath the compost. This will force warm air up into the compost and will help speed up the process by keeping the temperature warm during the winter.

In the winter, ensure snow does not come in direct contact with the manure pile. Snow can be a great insulator and should be allowed to fall on the compost, but only on top of a tarp. Direct contact of snow on the compost pile will often cause rapid cooling and slow or cease the composting process.

The composting process may cease completely once the air temperature is below freezing. It is important that the compost system is large enough to hold all the manure produced during the winter. The composting process will start up again in the spring once the temperature rises.

Pasture Management

Some poisonous plants and weed species to be aware of in this region include larkspur, alsike clover, water hemlock, burdock, orange hawkweed, hoary alyssum, Canada thistle and knapweed.

The best weed control method in the interior is mowing. Mow pastures after grazing to keep weeds down and maintain dense, even pasture grasses.

In this region of the province the soil is often alkaline; this can be a concern for pasture grass growth. You can decrease the soil pH (and make it more acidic) by using an organic mulch such as manure compost with a higher proportion of bedding. Other organic options are composted maple, beech, chestnut or oak leaves that can be spread on your pastures.

Be careful when choosing seed mixtures for the interior. Some choices for grass seed in the interior are bluegrasses, creeping red fescue, tall fescue, orchardgrass, wheatgrasses, white & red clovers and alfalfa.

Irrigate pastures when necessary in July and August, but avoid watering immediately after applying soil amendments or during wet times of the year.

Water Management

Efforts need to be made in this region to conserve water as the summers are particularly dry. Install livestock watering systems where appropriate to eliminate contamination of watercourses.

Install rain barrels to capture rain that does fall for use on gardens or compost pile.

E. Peace River

In the northeastern portion of the Province, to the east of the northern Rocky Mountains, lies an extension of the Alberta Great Plains. Cities such as Fort St. John and Dawson Creek experience long, cold winters and short, warm summers. There is a wide range of seasonal temperatures and the most precipitation is evident during the summer months. Dawson Creek has an average maximum of -9°C (16°F) in January and 22°C (72°F) in July. The average annual rainfall in Dawson Creek is 29.7 cm (11.7 in) while the annual snowfall is approximately 18.7 cm (7.4 in).

Waste Management

When composting manure be sure to keep the pile covered; this will help to retain heat and moisture within the pile in the colder winter months.

Water compost pile when necessary during July and August to maintain the appropriate moisture content. The compost pile should feel like a damp wrung-out sponge when squeezed.

If necessary, install a forced air system with PVC piping and an air compressor underneath the compost. This will force warm air up into the compost and will help speed up the process by keeping the temperature warm during the winter.

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The composting process may cease completely once the air temperature is below freezing. It is important that the compost system is large enough to hold all the manure produced during the winter. The composting process will start up again in the spring once the temperature rises.

Pasture Management

Weed species to be aware of in this region include larkspur, alsike clover, water hemlock, burdock, orange hawkweed, hoary alyssum, Canada thistle and knapweed.

The best weed control method in the interior is mowing. Mow pastures after grazing to keep weeds down and maintain dense, even pasture grasses.

In this region of the province the soil is often alkaline; this can be a concern for pasture grass growth. You can decrease the soil pH (and make it more acidic) by using an organic mulch such as manure compost with a higher proportion of bedding. Other organic options are composted maple, beech, chestnut or oak leaves that can be spread on your pastures.

Be careful when choosing seed mixtures for the interior. Some choices for grass seed in the interior are bluegrasses, creeping red fescue, tall fescue, orchardgrass, wheatgrasses, white & red clovers and alfalfa.

Water Management

Install rain barrels to capture rain that does fall in the summer months for use on gardens or compost pile.

F. Northwest Coast

The northwest coast generally receives a greater annual rainfall than regions such as the Georgia Basin and much cooler temperatures in both the winter and the summer. The Coast Mountains receive heavy snowfall in the winter and are typically drier than in the south. Summers are short and cool, but the long days often compensate for this. Precipitation is distributed evenly throughout the year and is quite light. Prince Rupert is the one of the wettest cities in BC with an annual rainfall of 295.3 cm (116.3 in). The average temperatures throughout the year range from -0.2°C (50.9°F) in January to 12.8°C (71.7°F) in July.

Waste Management

Since rainfall is so high in this region care must be taken to ensure manure piles or bins are covered from October 1st to April 1st. This will eliminate runoff into watercourses and prevent groundwater leaching.

In areas that fall under a rain shadow consistent watering of the manure pile in the dry summer months will be necessary.

Use alternative bedding to avoid woodwaste leachate from escaping.

Pasture Management

Sacrifice areas should be created in areas with wet pastures during the winter months. This will allow an area for horses to gain some exercise without destroying pasture grasses.

Drainage systems should be installed (either surface, subsurface or both) in pastures with standing water.

Lime pastures at least twice a year in the spring and fall to combat acidity and prevent weeds such as creeping buttercup (Ranunculus repens) and field horsetail (Equisetum arvense) from establishing

Avoid spreading manures, lime or fertilizers after October to eliminate leaching of nutrients into groundwater or nearby watercourses.

Use a seed mixture that is well suited to poorly drained, wet soils.

Water Management

Control storm water runoff to eliminate mud from developing by installing rain gutters and downspouts on barns and other outbuildings. Mud can cause health problems in horses such as mud fever, hoof abscesses, sand colic and thrush.

Use rain barrels to contain storm water for use on manure piles in dry summer months.

Canada – British Columbia Environmental Farm Plan

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What is environmental farm planning?

Environmental farm planning is a voluntary process that producers can use to identify both environmental strengths and any potential risks on their farms. As appropriate, it includes a prioritized action plan to reduce the risks.

Ensuring a consistent, national approach to environmental farm plans

Agriculture and Agri-Food Canada (AAFC) has developed a national approach on how environmental farm plan (EFP) programs will be developed and implemented across Canada. Through the national EFP program, a set of national principles will be used to ensure EFP programs are administered consistently on a province-by-province basis.

A national approach to EFP programs will bolster Canada's reputation as a grower and supplier of safe, high-quality foods that are produced in an environmentally responsible manner. While the approach is national, its flexibility takes into account regional, geographical, and climatic differences.

Why do we need environmental farm planning?

Consumers increasingly base their buying decisions on a desire to support environmental sustainability. Producers have shown they are admirable stewards of Canada's agri-environmental resources—they apply many good environmental practices that increase their profitability and benefit the environment.

Working together under the Agricultural Policy Framework, governments and industry are looking to accelerate efforts to reduce agricultural risks and provide benefits to Canada's water, soil, air, and biodiversity resources. Environmental farm planning is the foundation of that approach.

The Canada–British Columbia Environmental Farm Plan Program

The new Canada–British Columbia Environmental Farm Plan Program complements and enhances the current environmental stewardship practices of producers. Led by the province's agriculture and agri-food industry, this initiative encourages producers from all parts of the province to adopt beneficial management practices (BMPs) that enhance agricultural sustainability and contribute to a cleaner, healthier environment.

The program applies to all types and sizes of farm operations throughout the province. As participants in this program, producers are able to identify their farm's environmental strengths, prioritize any potential risks to the environment, and take advantage of tools and techniques available to manage those risks. Producers who develop and have an approved EFP become eligible to apply for cost-shared incentives through the National Farm Stewardship Program (NFSP) to implement actions identified in their plan.

Who can apply?

To apply for incentive funding under the National Farm Stewardship Program, producers must have an approved EFP, or must have participated in an Equivalent Agri-Environmental Plan (EAEP).

*Note: Any projects a producer starts before receiving both an approved EFP and a project proposal are not eligible for funding. In addition, the project must be completed and operational before claims can be reimbursed.

For more information on the Canada–British Columbia Environmental Farm Plan program, please contact:

British Columbia Agriculture Council (BCAC)
Environmental Farm Plan Coordinators

Niels Holbek, PAg
Tel: 1-877-334-6547 (within B.C.)
1-250-334-6547 (outside B.C.)
Fax: 1-250-337-5710
Web site: www.bcac.bc.ca/efp_programs.htm

Ron Bertrand, PAg
Tel: 604-308-6755
Fax: 604-854-4485
E-mail: rbertrand@shaw.ca

For more details on the Agricultural Policy Framework (APF), please call:

Toll-free telephone: 1-800-O-Canada (1-800-622-6232)
TTY for hearing- and speech-impaired clients: 1-800-465-7735
You can also visit the AAFC Web site at www.agr.gc.ca for details.

Environmental Farm Plan Planning Advisors for the Horse Council of BC (HCBC)

Vicki Pauze (Primary Contact)	British Columbia	604-856-4304 1-800-345-8055	
Sean Suggitt	Lower Mainland and Fraser Valley	604 299 0390	ssuggitt@telus.net
Lee Hardy	Vancouver Island and Gulf Islands	250 652 1618	poplarlanefarm@shaw.ca
Ken Huber	Cariboo and Okanagan	250 456 6050	huberx3@telus.net

For planning advisors for other commodity groups or independents please visit the BC Agriculture Council website at http://www.bcac.bc.ca/efp_contacts.htm .

For more information…

All technical information in this guide has been compiled from the following sources and has been peer-reviewed.

General Land Management

Manure Maiden
Email:info@manuremaiden.com
www.manuremaiden.com
The 'Resources' section of the website has information on horse manure composting and pasture management.

Horses for Clean Water
Alayne Blickle – Program Director
www.horsesforcleanwater.com
Lots of resources on the website for general use and some available for purchase.

Environmental Guidelines for Horse Owners in British Columbia
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Brent W. Auvermann, Lanny A. McDonald, Robert Devin, and John M. Sweeten
Texas Agricultural Extension Service
The Texas A&M University System
http://tcebookstore.org/tmppdfs/viewpdf_1091.pdf

How to Compost and Use Horse Manure
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King County Solid Waste Division, 2000
www.piercecountycd.org/tip_compmanure_p.html
ftp://dnr.metrokc.gov/dnr/library/2000/kcr737.pdf

Composting Horse Manure
Council of Bay Area Resource Conservation Districts
Equine Facilities Assistance Program, 2000
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Large Animal Disposal: On-Farm Burial Option, South Coastal Region of BC
Waste Management Factsheet
BC Ministry of Agriculture and Lands, 2006
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Pasture Management

Horse Pasture Renovation
Farm Structures Factsheet
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The Basics of Horse Pasture Management
Farm Structures Factsheet
Resources Management Branch
BC Ministry of Agriculture and Lands, 2005
www.agf.gov.bc.ca/resmgmt/publist/600series/649000-2.pdf

Quality Seeds West
Phone: (604) 574-7333
Email: support@qualityseedswest.com
www.qualityseedswest.com

Richardson Seed
Terralink Horticulture Inc
Phone: (604) 864-9044
Toll Free: 1-800-661-4559
Email: richseed@terralink-horticulture.com
www.terralink-horticulture.com

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Darren Bruhjell
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Glossary

Acidic soil	Soil with a pH value of less than 7.
Aeration	The process of replacing air in the soil by air in the atmosphere through mechanical or physical means. Poorly aerated soil usually contains more carbon dioxide and less oxygen than the surrounding atmosphere.
Aerobic	Occurs only in the presence of oxygen. Aerobic organisms can only grow in the presence of oxygen.
Agrochemicals	Chemicals such as hormones, fungicides or insecticides that are meant to improve the production of crops.
Algal Bloom	A population explosion of algae in surface waters such as lakes and streams, which is usually stimulated by nutrient enrichment by phosphorous and nitrogen.
Alkaline	Soil with a pH greater than 7.
Alsike Clover	A perennial European clover (Trifolium hybridum) with whitish or pinkish flowers grown as a pasture or hay plant. Toxicity of this clover can cause photosensitization or liver damage.
Anaerobic	Only occurs or functions in absence of oxygen. Anaerobic organisms can only grow without the presence of oxygen.
Aquifer	A saturated, permeable layer of sediment or rock that can transmit significant quantities of water under ordinary water pressures.
Biodiversity	The number or variety of species in a location, community or ecosystem.
Biosolids	Also known as sewage sludge. Settled sewage solids combined with water and dissolved materials, removed from sludge by screening, sedimentation, chemical precipitation or bacterial digestion.
Blue Baby Syndrome	Newborns with cyanotic syndrome. It is characterized by a blue colouration of the skin and mucous membranes due to the presence of deoxygenated hemoglobin in blood vessels near the skin surface or a reduction greater than 5gm% of hemoglobin.
Broadcast Overseed	The practice of adding more seed to a crop or pasture with a broadcast seeder, which sprays the seed evenly over the surface.
Buffer Strip	A less intensively managed and less disturbed area along the edge of an agricultural field or pasture that protects the adjacent natural system from potential negative agricultural impacts.
C:N Ratio	The Carbon : Nitrogen ratio. The ratio of the weight of organic carbon (C) to the weight of total nitrogen (N) in a soil or in organic material.
Catch Basin	A reservoir for collecting surface drainage or runoff.
Chain Harrow	A harrow consisting of a network of chains attached to a horizontal towing bar that is trailed across the soil or pasture to break up clods or disperse manure.
Composting	The natural recycling of organic matter such as grasses, leaves, branches, bark, kitchen wastes and manure. The process is carried out by microbes, fungi and other microorganisms such as earthworms and beetles, which break down this organic material into dark earthy smelling soil.
Corral	An enclosure or pen for horses, cattle, etc.
Crushed Rubber	Ground rubber fragments the size of sand or silt from running shoes or tires often used in riding arenas or rings.

Cultivation	A tillage operation used to prepare land for seeding or transplanting or for weed control and soil loosening.
Cushing's Disease	An endocrine disorder of humans, dogs and horses caused by a small benign tumour in the pituitary gland. Also known as hyperadrenocorticism.
Deleterious	Having a harmful effect.
Denitrification	The biochemical reduction of nitrate or nitrite to the gaseous form of nitrogen.
Diversion Berm	Also called a diversion dam. A structure or barrier built to divert some or all of the water from a stream to a different course. A berm generally refers to a build-up of soil or sediment.
Drainage Tile	A substance used to remove excess water from subsurface soil intended for agriculture. It consists of a network of underground pipes that allow subsurface water to move out of soil particles into the tile line where it is eventually deposited into surface water at a lower elevation.
Drainfield	An area of soil into which the effluent from a septic tank is piped so it will drain through the lower portion of the soil for disposal and purification.
Easy Keepers	A horse that is easy to keep or maintain in good weight and condition.
Endophyte	A plant, such as a fungus, usually a parasite.
Soil Erosion	The detachment of soil from the land surface by running water, wind, ice or other geological activity.
Coliform Bacteria	A collection of relatively harmless microorganisms that live in large numbers in the intestines of most animals. Fecal coliform bacteria are a subsection of these, the most common member being Escherichia coli. They are able to grow at elevated temperatures and only associated with the fecal material of warm-blooded animals. The presence of fecal coliform bacteria in aquatic environments indicates contamination with fecal material.
Feedlot	A plot of ground, often near a stockyard, where livestock are gathered to be fattened for market.
Ferment	The anaerobic conversion of sugar to carbon dioxide and alcohol by yeast.
Fertilizer	Any organic or inorganic material of natural or synthetic origin added to the soil to supply certain elements essential to the growth of plants.
Floodplain	The land adjacent to a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.
Foot Rot	An infectious and contagious disease that causes severe lameness. It is caused by the interaction of two anaerobic bacteria (Bacteroides nodosus and Fusobacterium necrophorum) that invade the foot and cause the disease.
Forage	Food for livestock.
Freeboard Safety	The distance between the normal water level and the top of a structure that restrains water.
Front End Loader	A type of tractor, usually wheeled, that uses a wide square tilting bucket on the end of movable arms to lift and move material.
Gelding	A castrated male animal.
Grazing muzzle	A muzzle that restricts the intake of food, but not water, and attaches to a halter.
Green Manure	Organic matter added to the soil when a cover crop (often a legume) is tilled into the soil.

Ground Cover	Also known as a cover crop. A close growing crop grown primarily for the purpose of protecting and improving soil between periods of regular crop production.
Groundwater	Subsurface water that infiltrates through the ground and accumulates in underground water bodies called aquifers.
Hardwood	The hard, compact wood or timber of deciduous trees such as the oak, cherry, maple or mahogany.
Harrowing	A secondary broadcast tillage operation which pulverizes, smoothes and firms the soil for seedbed preparation to control weeds or incorporate material spread on the surface.
Hedgerow	A row of closely planted shrubs or bushes that form a hedge.
Hog Fuel	Wood chips, shavings or other residue from sawmills used for fuel, landfills, animal feed, surfacing paths or for running tracks.
Hoof Abscesses	A collection of pus in the hoof due to tissue disintegration, which is surrounded by an inflamed area.
Hummocking	Soil that has been pushed up by pugging, which are hoof tracks left in soft soil caused by trampling.
Hydrocarbons	Any of numerous organic compounds, such as benzene or methane, that contain only carbon and hydrogen.
Immobilization	The conversion of an element from the inorganic to the organic form in microbial or plant tissues, thus rendering the element unavailable to other organisms or plants.
Incineration	To burn or reduce to ash.
Irrigation	Method by which water is artificially applied to an area.
Jaundice	Yellow discolouration of the skin and whites of the eyes due to an increase in bile pigments in the blood, often symptomatic of liver disease.
Laminitis	Inflammation of the sensitive laminae of the hoof caused by stressful events such as trauma or infection.
Leaching	The removal of materials in solution from the soil by percolating waters.
Legume	A pod-bearing member of the Leguminosae family. Includes many valuable food species such as peas, beans, peanuts, clovers, alfalfas, sweet clovers and vetches. Nearly all legumes are associated with nitrogen-fixing organisms.
Macronutrients	Nutrients plants need in large quantities such as carbon, nitrogen, oxygen, phosphorous, sulphur and water.
Mesophilic	Organisms that grow best at moderate temperatures between 25 and 40oC (77oF to 104oF).
Microclimate	The environmental conditions in the immediate vicinity of an organism.
Micronutrients	Nutrients necessary for the survival of plants but needed only in relatively small quantities.
Mud Fever	A chapped and inflamed condition of the skin of the legs and belly of a horse due to irritation from mud or drying resulting from washing off mud spatters.
Mulch	Any material such as straw, sawdust, leaves, plastic film, loose soil or horse manure that is spread on the surface of the soil to protect the soil and plant roots from raindrops, soil crusting, freezing or evaporation. It also helps to keep weed growth at a minimum.
Mycotoxins	Toxins produced by fungi.
Noxious Weeds	Weeds which are harmful or injurious to health or physical well being.
Paddock	An enclosed area, usually near a stable or barn, used to graze animals.

Palatable	Acceptable or agreeable to the taste.
Parasite	An organism that uses another organism for food and thus harms the other organism.
Pathogen	An agent that causes disease, especially a living microorganism such as a bacterium or fungus.
Photosensitive	Abnormally sensitive to light or similar radiation.
Pollution	The introduction of harmful substances or products into the environment.
Power Takeoff (PTO)	A mechanism attached to a motor vehicle engine that transfers power to another piece of equipment. For example, the mechanism that transfers engine power to mechanical implements such as a chain harrow attached to a tractor.
Pugging	Hoof tracks left in soft soil caused by trampling.
Polyvinyl Chloride (PVC)	A polymer of vinyl chloride.
Rain Barrel	A barrel used as a cistern to hold rainwater.
Rain Shadow	An area having relatively little precipitation due to the effect of a topographical barrier, especially a mountain range that causes the prevailing winds to lose their moisture before reaching it.
Raw Manure	Uncomposted or untreated manure.
Rejection Area	An area of the pasture or paddock where an animal avoids grazing.
Riparian Area	The area, both above and below the ground surface, directly adjacent to a watercourse that is influenced by annual inundation or flooding as well as rising and falling groundwater tables.
Rototilling	Also known as rotary tillage. An operation using a power-driven rotary tillage tool to loosen and mix soil.
Runoff	The portion of the precipitation on an area that is discharge from the area through stream channels. The water lost without entering the soil is called surface runoff, while the water that enters the soil before reaching the stream is called groundwater runoff.
Sacrifice Area	A small enclosure such as a paddock, corral, pen or turnout area that is meant to be a place for your horses to go when pastures are too wet or you want to limit grazing. It is called a sacrifice area because you are sacrificing this area for the benefit of your pastures.
Saline Soil	Soil that contains sufficient soluble salts to impair its productivity and the growth of plants.
Sand Colic	Abdominal pain caused by the ingestion and accumulation of sand.
Sediment	Transported and deposited particles or aggregates derived from soils, rocks or biological materials.
Setback Distance	The minimum distance between a watercourse and where a pasture or agricultural field can begin as required by ordinance.
Shelter Belt	A wind barrier of living trees and/or shrubs established and maintained for protection of agricultural fields.
Siltation	The deposition of waterborne sediments in stream channels, lakes, reservoirs or floodplains.
Slope	The degree of deviation of a surface from horizontal, measured in a numerical ratio, percent or degree.
Softwood	The soft, easily cut wood of coniferous trees such as fir, pine or cedar.

Soil Amendment	Any material, such as lime, gypsum, sawdust or synthetic conditioner, worked into the soil to make it more amenable to plant growth.
Soil Conditioner	Any material added to the soil for the purpose of improving its physical condition.
Soil Structure	The arrangement of soil particles into larger particles, units or pods. These units are classified based on size, shape and degree of distinctness into classes, types and grades.
Soil Texture	The relative proportions of the various soil separates in a soil such as sand, silt or clay.
Stewardship	The careful and responsible management of natural resources and the environment entrusted to one's care.
Sustainable	The fulfillment of the needs of the present generation without compromising the ability of future generations to meet their needs.
Thermophilic	Organisms that grow readily at temperatures above 45oC (113oF).
Thrush	A diseased condition of the frog of the foot in horses, characterized by a foul-smelling discharge and often resulting from unhygienic stall conditions.
Tillage	The mechanical manipulation of soil for any purpose. Usually used in agriculture to modify the soil conditions for crop production.
Topsoil	The layer of soil moved in cultivation, which is generally fertile soil material used to top-dress roadbanks, gardens and lawns.
Tributary	A stream that flows into a larger stream or other body of water.
Volatilize	To evaporate or cause to evaporate.
Water Bar	A ditch in a trail, road or woods that diverts surface water off the trail/road surface to avoid or minimize soil erosion.
Watercourse	A natural or artificial channel through which water flows.
Water-Holding Capacity	The amount of water in soil that can be absorbed by plants between the high amount at full saturation and the low amount at the permanent wilting capacity.
Watershed	An area of land that catches rain and snow, which drains or seeps into surface water (i.e. streams, creeks, ditches, swamps and wetlands) or groundwater. It is a surface drainage basin that is defined by the heights of the land such as ridges and hills.
Wetland	An area of land that has very wet soil and water-loving vegetation, typically flooded for part of the year, and forming a transitional zone between aquatic and terrestrial systems.
Wildlife Corridor	A stretch of nature that facilitates the migration of animals.
Windrow	A long row or line made for the purpose of drying or composting.

Langley Environmental Partners Society (LEPS)

Langley Environmental Partners Society (LEPS) was formed in 1993 as a partnership between local community stewardship groups, environmental organizations, educational institutions, First Nations, local government, and provincial and federal government agencies. LEPS is a non-profit, partnership-driven organization dedicated to protecting and restoring the natural environment through education, co-operation and action. Our activities are primarily focused in the following areas:

- Watershed Stewardship
- Habitat Conservation and Restoration
- Mapping and Data Collection
- Agricultural Stewardship
- Education and Outreach

Manure Management Education for Small-Lot Farmers in BC

The Manure Management Education program is run by Langley Environmental Partners Society (LEPS) with a mandate to provide province-wide promotion and facilitation of on-site composting of manure. Since 2005 LEPS has been educating and providing technical assistance to equestrian and small-lot landowners throughout BC in regards to proper management of livestock manure including storage, handling, composting and pasture management. The 'Manure Maiden' carries out site consultations and workshops on the most pressing manure management concerns and provides alternatives to conventional land management practices.

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